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WAS MIDDLE AMERICA PEOPLED FROM ASIA?

By Prof. EDWARD S. MORSE.

THE controversies over the question of the origin of Central American culture are to be again awakened by the exploration organized under the direction of the American Museum of Natural History through the liberality of its president, Morris K. Jesup, Esq. The plans embrace an ethnographic survey of the races between the Columbia and Amoor Rivers. Many similarities in customs, folk-lore, etc., will doubtless be found among these northern races. How far traces of an ancient avenue will be established through which came the unique cult of middle America, and for which in a way the surveys have been instituted, remains to be seen. The question is one of perennial interest, and all honor to the scientific spirit of Mr. Jesup, whose munificence has provided the means for this work.

It may be of interest to remind those who have only a vague idea of the contention that there are many earnest scholars who insist that the wonderful architectural remains in Mexico, Yucatan, and other regions of the west coast are due to Asiatic contact in the past. As proofs of this contact are cited similarities as seen in the monuments, the facial characteristics of certain tribes, ancient customs, astronomical ideas, serpent worship, certain games, etc. Particularly is it believed by the scholars that the "land of Fusang" mentioned in early Chinese historical records is no other than Mexico or some contiguous country.

Space will not permit even the briefest mention of the evidences which have led to these conclusions, and the reader is referred to a remarkably condensed history of the whole question embodied in a volume by Mr. Edward P. Vining entitled An Inglorious Columbus. Under this unfortunate title one may find the most painstaking collocation of the many memoirs written upon this subject, with the Chinese account of the land of Fusang in Chinese characters, and appended thereto the various translations of the document by De Guines, Williams, Julien, and other eminent sinologues.

To the French Orientalist, M. de Guines, we are indebted for our first knowledge of certain ancient records of the Chinese, which briefly record the visit of Chinese Buddhist monks to the land of Fusang in the year 458 of our era, and the return of a single Buddhist monk from this land in 499. De Guines's memoir appeared in 1761, and for forty years but little attention was drawn to it. Humboldt says that, according to the learned researches of Father Gaubil, it appears doubtful whether the Chinese ever visited the western coast of America at the time stated by De Guines. In 1831, Klaproth, the eminent German Orientalist, combated the idea that Fusang was Mexico, and insisted that it was Japan. In 1844 the Chevalier de Paravey argued that Fusang should be looked for in America. Prof. Karl Friedrich Neumann also defended this idea. In magazine articles in 1850–1862, and finally in book form in 1875, Mr. C. G. Leland supported with great ingenuity the idea of Chinese contact based on the Fusang account. In 1862 M. José Perez also defended the idea. In 1865 M. Gustave d'Eichthal published his memoir on the Buddhistic origin of American civilization, and in the same year M. Vivien de Saint-Martin combated the theory, and since that time many others have written upon the subject in favor or in opposition to the idea of Asiatic contact.

These hasty citations are only a few of the many that I have drawn from Mr. Vining's encyclopedic compilation.

It is extraordinary what a keen fascination the obscure paths of regions beyond history and usually beyond verification have to many minds, and the fascination is as justifiable as the desire to explore unknown regions of the earth. In the one case, however, we have a tangled mass of legendary tales coming down from a time when dragons were supposed to exist, when trees were miles in height, when people lived to a thousand years, when every unit of measurement was distorted and every physical truth, as we know it to-day, had no recognition, while in the other case we have at least a continuity of the same land and sea extending to the unexplored beyond. This impulse of the human mind finds an attractive problem in the question as to the origin of the American races. Dr. Brinton has insisted on the unreasonable nature of the inquiry by asking an analogous one: "Whence came the African negroes? All will reply, 'From Africa, of course.' 'Originally?' 'Yes, originally; they constitute the African or negro subspecies of man.' " By bringing together isolated features which have resemblances in common, the American Indian has been traced to nearly every known stock. Mr. Henry W. Henshaw, in an admirable address entitled Who are the American Indians? says: " If you have special bias or predilection you have only to choose for yourself. If there be any among you who decline to find the ancestors of our Indians among the Jews, Phœnicians, Scandinavians, Irish, Welsh, Egyptians, or Tartars, then you still have a choice among the Hindu, Malay, Polynesian, Chinese, or Japanese, or indeed among almost any other of the children of men." Had this address been written a few years later he might have added Hittite!

There are two propositions involved in the controversy as to the Asiatic origin of the American race: the one is that America was peopled from Asia by invasions or migrations in pre-savage or preglacial times; the other is that the peculiar civilization of Central America was induced by Buddhist monks, who traveled from Asia to Mexico and Central America in the fifth century of our era. Those who sustain the first thesis are without exception men trained in the science of anthropology; those who sustain the second thesis are with a few conspicuous exceptions travelers, geographers, sinologues, missionaries, and the like.

If Asia should ever prove to be the cradle of the human race, or of any portion of it which had advanced well beyond the creature known as *Pithecanthropus erectus*, then unquestionably an Asian people may be accounted the progenitors of the American Indians. Any effort, however, to establish an identity at this stage would probably take us far beyond the origin of speech or the ability to fabricate an implement.

The controversy has not raged on this ground, however; the numerous volumes and memoirs on the subject have dealt almost exclusively with culture contacts or direct invasions from Asia in our era, and more particularly with the supposed visits of Chinese Buddhist monks to Mexico and Central America already alluded to. Believing in the unity of the human race, the dispersion of the species seems more naturally to have occurred along the northern borders of the great continents rather than across the wide ocean. From the naturalist's standpoint the avenues have been quite as open for the circumpolar distribution of man as they have been for the circumpolar distribution of other animals and plants down to the minutest land snail and low fungus. The ethnic resemblances supposed to exist between the peoples of the two sides of the Pacific may be the result of an ancient distribution around the northern regions of the globe. Even to-day social relations are said to exist between the peoples of the Mackenzie and the Lena delta, and it is not improbable that the carrying band of the Ainu in Yeso and a similar device depicted on ancient codices and stone monuments in Mexico may have had a common origin. Advancing to a time when man acquired the art of recording his thoughts, the question of any contact between the peoples of the eastern and western shores of the Pacific, south of latitude 40°, compels us to examine the avenues which have been so potent in the distribution of life in the past—namely, the oceanic currents. We are at once led to the great Japan current, the Kuro Shiwo, which sweeps up by the coast of Japan and spends its force on the northwest coast of America. Records show a number of instances of Japanese junks cast ashore on the Oregon coast and shores to the north.*

It must be evidences of Japanese and not Chinese contact that we are to look for—tangible evidences, for example, in the form of relics, methods of burial, etc. That the Japanese bear resemblances to certain northern people there can be no doubt. Dr. Torell brought before the Swedish Anthropological Society, some years ago, the results of a comparative study of Eskimo and Japanese. The anatomical and ethnographical resemblances appeared so striking to him as to give additional strength to the theory of the settlement of America from Asia by way of Bering Strait. That there are certain resemblances among individuals of different races we have abundant evidences. At a reception in Philadelphia I introduced a Japanese commissioner (who had been a Cambridge wrangler) to a full-blooded Omaha Indian dressed in our costume, and the commissioner began a conversation with him in Japanese; nor could he believe me when I assured him that it was an Indian that he was addressing, and not one of his own countrymen. I was told by an *attaché* of the Japanese legation at Washington that after carefully scrutinizing the features of a gentleman with whom he was traveling he ventured to introduce himself as a fellow-countryman, and found to his astonishment that the man was a native of the Malay Peninsula. That the Malays bear a strong resemblance to the Chinese is quite true. Dr. Baelz, of the Medical College of Japan, can find no differences between the crania and pelves of the Chinese and Malays. Wallace assures us that even the Malay of Java, when

* Mr. Charles Walcott Brooks presented to the California Academy of Sciences a report of Japanese vessels wrecked on the North Pacific Ocean in which many instances are given. He says: "Every junk found stranded on the coast of North America or on the Hawaiian or adjacent islands has, on examination, proved to be Japanese, and no single instance of a Chinese vessel has ever been reported, nor is any believed to have existed. . . . There also exists an ocean stream of cold water emerging from the Arctic Ocean which sets close in along the eastern coast of Asia. This fully accounts for the absence of Chinese junks on the Pacific, as vessels disabled off their coast would naturally drift southward."

dressed as a Chinese, is not to be distinguished from them, and Peschel classifies the Malays with the Mongoloid people. In these approximate regions one might expect close intermixtures. If resemblances are established between the Japanese and the Eskimo, they would probably have arisen from a circumpolar race which has left its traces on northern peoples the world around. We turn naturally to Japan as the region from which a migration might reasonably have been supposed to take place. Its position on the Asiatic coast with a series of larger and smaller stepping-stones—the Kuriles—to Kamchatka, and thence across the strait to America and seaward, the broad and powerful Japanese current sweeping by its coast and across the Pacific, arrested only by the northwestern coast of America. With these various avenues of approach one might certainly expect evidences of contact in past times. A somewhat extended study in Japan of its prehistoric and early historic remains in the way of shell-heap pottery from the north to the south, much of it of an exceedingly curious character; the later stone implements, many of them of the most extraordinary types; the bronze mirrors, swords, spear points, and the so-called bronze bells; the wide distribution of a curious comma-shaped ornament of stone known as the *magatama*, with a number of varieties, and many other kinds of objects, leads me to say that no counterpart or even remote parallelism has been found in the western hemisphere. Certain rude forms of decoration of the northern shell-heap pottery of Japan, such as the cord-mark and crenulated fillet, are world-wide in their distribution, and a similar wide dispersal is seen of the rude stone implements and notched and barbed bone and horn. Here, however, the similarity ends. The lathe-turned unglazed mortuary vessels so common in ancient graves in Japan and Korea have equally no counterpart on our western coast. If now we examine the early records of Japan in her two famous works—the Kojiki and Nihonji, which contain rituals, ceremonies, and historical data going back with considerable accuracy to the third and fourth centuries of our era—we shall find many curious details of customs and arts and references to objects which have since been exhumed from burial mounds, yet we look in vain for a similar cult in Mexico or Central America. Turning aside from Japan as an impossible ground in which to trace resemblances, we glance at the unique character of the ancient pottery of Central America, with its representations of natural forms, such as fishes, turtles, frogs, shells, etc., its peculiar motives of decoration in color, and find no counterpart in Asia. The pyramidal rock structure and rounded burial mounds are supposed to have their counterparts in the East, but the pyramidal form is common in various parts of the world, simply because it is the most economical and most enduring type of architecture, and facilitates by its form the erection of the highest stone structures. The rounding dome of an earth mound and the angular side of a rock pyramid are the result of material only.

If we now turn to China as a possible region from which migrations may have come in the past, we have only to study the historical records of that ancient people to realize how hopeless it is to establish any relationship. Let one study the Ceremonial Usages of the Chinese (1121 B. C.—translated by Gingell), and he will then appreciate the wonderful advancement of the Chinese at that early date—the organized government, the arts, customs, manufactures, and the minute observances and regulations concerning every detail of life. With these records before him he may search in vain for the direct introduction of any art or device described in this old Chinese work. A few similarities are certainly found between the East and the West, but these arise from the identity in man's mental and physical structure. With two legs only, for example, it is found difficult to sit on a seat comfortably in more than a few ways. One may sit with both legs down, with one leg under, with legs crossed *à la* Turk, or the unconventional way throughout the world with one leg over the other at various angles. It would seem with this limited number of adjustments that any similarities in the attitude of certain stone statues in America and Asia could have but little weight. Prof. F. W. Putnam believes that he has established an Asiatic origin of certain jade ornaments found in Central America. If this conclusion could be sustained, we should then have evidences of contact with an Asiatic people in the stone age, which in itself was one of great antiquity for the Chinese, and one long antedating the origin of Buddhism. In the Chinese work above alluded to the whetstone is mentioned for sharpening swords, and the craft employed in polishing the musical stone. Confucius also refers to the musical stone in his Analects. This is as near as we get to the use of stone eleven hundred years before Christ. It is to the merit of Putnam to have first called attention to the fact that many of the jade ornaments, amulets, etc., of Central America had originally been portions of jade celts. The discovery is one of importance, whatever explanation may be reached as to the origin of the stone. In Costa Rica these celt-derived ornaments have been cut from celts composed of the native rock, and it would seem that these old implements handed down in the family led to their being preserved in the form of beads, amulets, etc., much in the same spirit that animates us to-day in making paper-cutters, penholders, and the like from wood of the Charter Oak, frigate Constitution, and other venerated relics. Among other evidences of contact the existence of the Chinese calendar in Mexico is cited. Dr. Brinton shows, however, that the Mexican calendar is an indigenous production, and has no relation to the calendar of the Chinese. In a similar way the Mexican game of *patolli* is correlated with the East Indian game of *parchesi* by Dr. E. B. Tylor. Dr. Stewart Culin, who has made a profound study of the games of the world, and Mr. Frank Hamilton Cushing, the distinguished student of the ethnology of southern North America, are both convinced that this game had an independent origin in various parts of the world. Mexican divisions of time marked by five colors are recognized as being allied to a similar device in China. The application of colors to the meaning of certain ideographs is common in other parts of the world as well. It is important to remark that the colors named include nearly the whole category as selected by barbarous people, and in the use of colors in this way it would be difficult to avoid similarities.

The evidences of contact in early times must be settled by the comparison of early relics of the two shores of the Pacific. Resemblances there are, and none will dispute them, but that they are fortuitous and have no value in the discussion is unquestionable. As illustrations of these fortuitous resemblances may be cited a tazza from the United States of Colombia having a high support with triangular perforations identical in form with that of a similar object found among the mortuary vessels of Korea, and Greece as well. A curious, three-lobed knob of a pot rim, so common in the shell mounds of Omori, Japan, has its exact counterpart in the shell mounds of the upper Amazon. In the Omori pottery a peculiar curtain-shaped decoration on a special form of jar has its exact parallel in the ancient pottery of Porto Rico. These instances might be multiplied, but such coincidences as are often seen in the identity of certain words are familiar to all students. The account of the land of Fusang appears in the records of the Liang dynasty contained in the Nanshi, or History of the South, written by Li Yen-Shau, who lived in the beginning of the seventh century. It purports to have been told by a monk who returned from the land of Fusang in 499 of our era. This hypothetical region has been believed to be Japan, Saghalin, and Mexico. The record is filled with fabulous statements of impossible animals, trees of impossible dimensions, and is so utterly beyond credence in many ways that it should have no weight as evidence. If it had any foundation in fact, then one might infer that some traveler had entered Saghalin from the north, had crossed to Yeso and Japan, and found his way back to China. His own recollections, supplemented by stories told him by others, would form the substance of his account. The record is brief, but any one familiar with Japan as Klaproth was is persuaded with him that the account refers to Japan and adjacent regions. The twenty thousand *li* the monk is said to have traveled may parallel his mulberry trees several thousand feet high and his silkworms seven feet long. In a more remote Chinese record, as mentioned by Dr. Gustave Schlegel, the statement is made that the inhabitants had to dig down ten thousand feet to obtain blue tenacious clay for roofing tiles! A number of ardent writers convinced that signs of Chinese contact are seen in the relics of middle America have seized upon this account of Fusang in support of this belief. These convictions have arisen by finding it difficult to believe that the ancient civilizations of Mexico and Peru could have been indigenous. In seeking for an exterior origin in the Fusang account overweight has been credited to every possible resemblance, and all discrepancies have been ignored.

The fabulous account of the land of Fusang evidently supplied documentary evidence, and Mexico was conceived to be the mythical Fusang. Mr. Vining goes so far as to declare that "some time in the past the nations of Mexico, Yucatan, and Central America were powerfully affected by the introduction of Asiatic arts, customs, and religious belief." To establish the details in the Chinese account the entire western hemisphere is laid under contribution: now it is the buffalo of North America, then the llama of Peru, the reindeer of the arctic, or some native word. These writers do not hesitate to bring to life animals that became extinct in the upper Tertiaries, and to account for the absence of others by supposing them to have become extinct. Literal statements of horses dragging wheeled vehicles are interpreted as an allusion in Buddhist cult which refers by metaphor to attributes and not to actual objects. As an illustration of the wild way in which some of these resemblances are established, Mr. Vining quotes the account of M. José Perez (*Revue Orientale et Américaine*, vol. viii). Perez reminds us that the inhabitants of the New World gave Old World names to places in the new continent, citing New York, New Orleans, and New Brunswick as examples, and then says that at some remote epoch the Asiatics had given to the cities of the New World the same names as the cities of their mother country; so the name of the famous Japanese city Ohosaka (Osaka), to the west of the Pacific, became Oaxaca in Mexico on the eastern side. Now it is well known that the ancient name of Osaka was Namihawa; this became corrupted into Naniwa, and not till 1492 does the name Osaka appear. Rev. J. Summers gives a full account of these successive names with their meanings (Transactions of the Asiatic Society of Japan, vol. vii, part iv). The real question to be answered is not what might have been accomplished by ancient explorers from Asia, but what was accomplished. It is shown that Chinese Buddhist priests went to India in the years

388, 399, 629, and so on, and the question is asked, Why may they not have reached Mexico on the east? Migration on parallels of latitude with no intervening ocean is one matter; to go from latitude 30° on one side of the Pacific almost to the Arctic Ocean, and down on the other side nearly to the equator, is quite another exploit. It is assumed that five priests had gone to Mexico in 468 A. D., and there ingrafted Buddhistic cult on the races with whom they came in contact. It is simply beyond reason to believe that the introduction of Buddhism into Mexico antedated by half a century its introduction into Japan. Communication between Korea and Japan has been from the earliest times one without effort or peril: in the one case a trip of a day or more, in the other case a journey of unnumbered thousands of miles through perilous seas, across stormy fiords and raging waters, including arctic and tropical climates and contact with multitudinous savage hordes. Those who hold that Mexico and Central America were powerfully affected by Asiatic contact must be called upon to explain the absence of certain Asiatic arts and customs which would have been introduced by any contact of sufficient magnitude to leave its impress so strongly in other directions. A savage people takes but little from a civilized people save its diseases, gunpowder, and rum. The contact of barbarous with civilized people results in an interchange of many useful objects and ideas, but these introductions must be through repeated invasions and by considerable numbers. Peschel, while believing in the Asiatic origin of the American race, would place the time far back in the savage state. He repudiates the Fusang idea, and expresses his belief that "a high state of civilization can not be transmitted by a few individuals, and that the progress in culture takes place in dense populations and by means of a division of labor which fits each individual into a highly complex but most effective organization," and then insists that "the phenomena of American civilization originated independently and spontaneously"; and Keane shows how interesting the social, religious, and political institutions of America become when "once severed from the fictitious Asiatic connection and influences." That the savage derives little or derives slowly from contact with a superior race is seen in the fact that he still remains savage. Thus the Ainu, a low, savage people, though they have been in contact with the Japanese for nearly two thousand years, have never acquired the more powerful Mongolian arrow release, while the Persians, though Aryan, yet early acquired this release from their Mongolian neighbors. The Scandinavians, who in prehistoric times practiced the primary release, yet later acquired the more efficient Mediterranean method. Let us for a moment consider what would have occurred as a result of an Asiatic contact with a people advanced enough to have been powerfully affected in their "arts, customs, and religious belief." It seems reasonable to believe that traces of a Mongolian release would be found in Central America, the more so as a warlike people would eagerly seize upon a more powerful method of pulling the bow, yet no trace of a stone or metal thumb ring has ever been found in the western hemisphere. Ancient Mexican codices, while depicting the archer, reveal no trace of the Mongolian method. In the Old World this release crept westward as a result of the migration of, or contact with, Asiatic tribes, and metal thumb rings are dug up on the Mediterranean littoral. While the arrow release of China might not have effected a lodgment in America, the terra-cotta roofing tile certainly would. This important device, according to Schlegel, was probably known in China 2200 B. C., in Korea 500 B. C., and in Japan in the early years of our era. In the ancient records of Japan reference is made to "breaking a hole in the roof tiles of the hall," etc., and green-glazed tiles are dug up on the sites of ancient temples in Japan. The fragments are not only unmistakable but indestructible. I have shown elsewhere * that the primitive roofing tile crept into Europe from the East, distributing itself along both shores of the Mediterranean, and extending north to latitude 44°. Graeber finds its earliest use in the temple of Hira in Olympia, 1000 B. C. The ancient Greeks had no knowledge of the roofing tile. Among the thousands of fragments and multitudinous articles of pottery found by Schliemann in the ruins of Ilios, not a trace of the roofing tile was discovered. One is forced to believe that so useful an object, and one so easily made, would have been immediately adopted by a people so skillful in the making of pottery as the ancient Mexicans. Certainly these people and those of contiguous countries were equal to the ancient Greeks in the variety of their fictile products. Huge jars, whistles, masks, men in armor, curious pots of an infinite variety attest to their skill as potters, yet the western hemisphere has not revealed a single fragment of a pre-Columbian roofing tile. Vining, in his work, cites an observation of the Rev. W. Lobscheid, the author of a Chinese grammar. In crossing the Isthmus of Panama this writer was much struck with the similarities to China; "the principal edifices on elevated ground and the roofing tiles identical to those of China." The roofing tile is indeed identical with that of China. It is the form that I have elsewhere defined as the normal or Asiatic tile, but it reached America for the first time by way of the Mediterranean and Spain, and thence with the Spaniards across the Atlantic, where it immediately gained a footing, and

* On the Older Forms of Terra-Cotta Roofing Tiles. Essex Institute Bulletin, 1882.

rapidly spread through South America and along the west coast north, as may be seen in the old mission buildings in California.

In China, Korea, and Japan the sandal has a bifurcated toe cord, the base of which, springing from the front of the sandal, passes between the first and second toes. It belongs to the Old World through its entire extent. It is the only form represented in ancient Egyptian, Assyrian, and Greek sculpture. One would have expected that with any close contact with Asian people this method of holding the sandal to the foot would have been established in Central America, yet one may seek in vain for the evidences of even a sporadic introduction of this method. Where representations are given in the sculptured stone pottery, or codex, the sandal is represented with two cords, one passing between the first and second and the other between the third and fourth toes. Dr. Otis T. Mason, who has given us an exhaustive monograph of the foot gear of the world, says that every authority on Mexico and Central America pictures the sandal with two cords, and he further says, in a general article on the same subject, "An examination of any collection of pottery of middle America reveals the fact at once, if the human foot is portrayed, that the single toe string was not anciently known."

The Thibetans, Chinese, Koreans, and Japanese have used the serviceable carrying stick from time immemorial. The nearest approach to this method in this country is seen in Guadalajara, where a shoulder piece is used to carry jars. The representation of this method shows that the pole rests across the back in such a manner that the load is steadied by both the right and left hand simultaneously—identical, in fact, with methods in vogue to-day through western Europe. We find, however, the northern races, as the Ainu and Kamchadels, use the head band in carrying loads, and this method has been depicted in ancient American sculpture. The carrying stick, so peculiarly Asiatic, according to Dr. Mason, is not met with on this continent.

With the evidences of Asiatic contact supposed to be so strong in Central America, one might have imagined that so useful a device as the simple chopsticks would have secured a footing. These two sticks, held in one hand and known in China as "hasteners or nimble lads," are certainly the most useful, the most economical, and the most efficient device for their purposes ever invented by man. Throughout that vast Asian region, embracing a population of five hundred million, the chopstick is used as a substitute for fork, tongs, and certain forms of tweezers. Even fish, omelet, and cake are separated with the chopsticks, and the cook, the street scavenger, and the watch repairer use this device in the form of iron, long bamboo, and delicate ivory. The bamboo chopstick was known in China 1000

B. C., and shortly after this date the ivory form was devised. Their use is one of great antiquity in Japan, as attested by references to it in the ancient records of that country. One may search in vain for the trace of any object in the nature of a chopstick in Central or South America. Knitting needles of wood are found in the work baskets associated with ancient Peruvian mummies, but the chopstick has not been found. Curious pottery rests for the chopsticks are exhumed in Japan, but even this enduring testimony of its early use is yet to be revealed in this country.

The plow in all its varieties has existed in China for countless centuries. Its ideograph is written in a score of ways. It was early introduced into Korea and Japan, and spread westward through the Old World to Scandinavia. There it has been found in the peat bogs. It is figured on ancient Egyptian monuments, yet it made its appearance in the New World only with the advent of the Spaniards. This indispensable implement of agriculture when once introduced was instantly adopted by the races who came in contact with the Spaniards. Even in Peru, with its wonderful agricultural development and irrigating canals, no trace of this device is anciently known, and to-day the tribes of Central and South America still follow the rude and primitive model first introduced by their conquerors.

If we study the musical instruments of the New World races we find various forms of whistles, flutes, rattles, split bells, and drums, but seek in vain for a stringed instrument of any kind. This is all the more surprising when we find evidences of the ancient use of the bow. If Dr. Tylor is right, we may well imagine that the lute of ancient Egypt was evolved from the musical bow with its gourd resonator (so common in various parts of Africa), and this in turn an outgrowth of the archer's bow, or, what at the moment seems quite as probable, the musical bow might have been the primitive form from which was evolved the archer's bow on the one hand and the lute on the other. Dr. Mason, in a brief study of the musical bow, finds it in various forms in Africa and sporadic cases of it in this country, and expresses the conviction that stringed musical instruments were not known to any of the aborigines of the western hemisphere before Columbus. Dr. Brinton is inclined to dispute this conclusion, though I am led to believe that Dr. Mason is right; for had this simple musical device been known anciently in this country, it would have spread so widely that its pre-Columbian use would have been beyond any contention. In Japan evidences of a stringed instrument run back to the third or fourth century of our era, and in China the *kin* (five strings) and *seih* (thirteen strings) were known a thousand years before Christ. These were played in temples of worship, at religious rites, times of offering, etc. It seems incredible that any contact sufficient to affect the religious customs of Mexico or Central America could have occurred without the introduction of a stringed instrument of some kind.*

In the Ceremonial Usages of the Chinese (1100 B. C.), a work already referred to, one may find allusions to a number of forms of wheeled carriages, with directions for their construction. Minute details even are given as to material and dimensions, such as measuring the spoke holes in the rim with millet seed (reminding one of the modern method of ascertaining the cubic contents of crania), all indicating the advanced development of wheeled vehicles. If from this early date in China up to the fifth century A. D., any people had found their way from China to middle America, one wonders why the wheel was not introduced. Its absence must be accounted for. It was certainly not for lack of good roads or constructive skill. Its appearance in this hemisphere was synchronous with the Spanish invasion, and when once introduced spread rapidly north and south. Like the plow, it still remains to-day the clumsy and primitive model of its Spanish prototype.

The potter's wheel is known to have existed in Asia from the earliest times; the evidence is not only historical, but is attested by the occurrence of lathe-turned pottery in ancient graves. We look in vain for a trace of a potter's wheel in America previous to the sixteenth century. Mr. Henry C. Mercer regards a potter's device used in Yucatan as a potter's wheel, and believes it to have been pre-Columbian. This device, known as the *kabal*, consists of a thick disk of wood which rests on a slippery board, the potter turning the disk with his feet. The primitive workman uses his feet to turn, hold, and move objects in many operations. The primitive potter has always turned his jar in manipulation rather than move himself about it. Resting the vessel on a block and revolving it with his feet is certainly the initial step toward the potter's wheel, but so simple an expedient must not be regarded as having any relation to the true potter's wheel, which originated in regions where other kinds of wheels revolving on pivots were known.

It seems reasonable to believe that had the Chinese, Japanese, or Koreans visited the Mexican coast in such numbers as is believed they did, we ought certainly to find some influence, some faint strain, at least, of the Chinese method of writing in the hitherto unfathomable inscriptions of Maya and Aztec. Until recently it was not known whether they were phonetic or ideographic; indeed, Dr. Brin-

* Since the above was written Dr. Brinton and Mr. Saville have called my attention to such evidences as would warrant the belief in the existence of a pre-Columbian stringed musical instrument. The devices are, however, of such a nature as to indicate their independent origin.

ton has devised a new word to express their character, which he calls ikonomatic. This distinguished philologist of the American languages confesses that not even the threshold of investigation in the solution of these enigmatical puzzles has been passed. Had the Chinese introduced or modified or even influenced in any way the method of writing as seen on the rock inscriptions of Central America, one familiar with Chinese might have found some clew, as was the case in deciphering the ancient writings of Assyria and Egypt. Grotefend's work on cuneiform inscriptions and Champollion's interpretation of Egyptian came about by the assumption of certain inclosures representing historic characters, which were revealed in one case by an inference and in another by an accompanying Greek inscription. If we examine the early Chinese characters as shown on ancient coins of the Hea dynasty (1756 to 2142 B. C), or the characters on ancient bronze vases of the Shang dynasty 1113 to 1755 B. C), we find most of them readily deciphered by sinologists, and coming down a few centuries later the characters are quite like those as written to-day. On some of the many inscribed stone monuments of Central America one might expect to find some traces of Chinese characters if any intercourse had taken place, whereas the Maya glypts are remotely unlike either Chinese or Egyptian writing. Some acute students of this subject are inclined to believe that these undecipherable characters have been evolved from pictographs which were primarily derived from the simple picture writing so common among the races of the New World.

It seems clearly impossible that any intercourse could have taken place between Asia and America without an interchange of certain social commodities. The "divine weed," tobacco, has been the comfort of the races of the western hemisphere north and south for unnumbered centuries: stone tobacco pipes are exhumed in various parts of the continent; cigarettes made of corn husks are found in ancient graves and caves; the metatarsals of a deer, doubly perforated, through which to inhale tobacco or its smoke in some form, are dug up on the shores of Lake Titicaca.

The question naturally arises why tobacco was not carried back to Asia by some of the returning emigrants, or why tea was not introduced into this country by those early invaders. A Buddhist priest without tea or tobacco would be an anomaly. There are many other herbs, food plants, etc., that should not have waited for the Spanish invasion on the one hand, or the Dutch and Portuguese navigator along the Chinese coast on the other.

Finally, if evidences of Asiatic contact exist, they should certainly be found in those matters most closely connected with man, such as his weapons, clothing, sandals, methods of conveyance, pottery making and devices thereon, musical instruments, and above all house structure and modes of burial. More remote perhaps would be survivals of language, and if the invaders had a written one, the characters, whether phonetic or ideographic, would have been left in the enduring rock inscriptions. If now a study of the aborigines of the western hemisphere from Hudson Bay to Tierra del Fuego fails to reveal even a remote suggestion of resemblance to any of these various matters above enumerated, their absence must in some way be accounted for by Asiaticists.

THE POSSIBLE FIBER INDUSTRIES OF THE UNITED STATES.

By CHARLES RICHARDS DODGE.

THE wealth of any community is dependent on the variety and extent of its industries, the utilization of local natural resources, and the employment of the labor of all classes of its population. In locations of successful industrial operations the farmer derives increased incomes, the value of his products is greater, his lands of higher value, and the wages of agricultural labor larger. The rural population contiguous to large towns, therefore, is more prosperous than the larger farming contingent more remote from manufacturing or industrial centers. The farmers of the first class are prosperous because they have a home market for their dairy products, fruits, vegetables, and other "truck," which they are able to produce, for the most part, on small areas by high culture, while those of the second class are forced to expend their energies on commercial commodities such as cotton, wool, meat, grain, etc., with long hauls in transportation, and with heavy competition, international as well as domestic.

In times of depression, or when competition has grown too heavy, the cultivation of certain staples may cease to be remunerative, and the unfortunate producer is compelled to diversify his agriculture, or adopt some other means of livelihood.

Just such a misfortune has overtaken many farmers in the United States within the past few years. Within two years, in fact, wheat has been a drug in the market, while corn has been cheaper in some sections than coal, and cotton is now so low that it hardly pays to grow it, without considering the necessity, for the Southern farmer, of competing against the seventy-five thousand bales of Egyptian cotton which enter our ports in a year. Confronted with these conditions, there never has been a time when farmers were more anxious to discover new paying crops. Among the possible new rural industries that have attracted the attention of the agricultural class is that of fiber production, though the growth of certain kinds of fibers in past time has been a source of income to the country. Already there is a widespread interest in the subject throughout the West and South, and farmers are only seeking information regarding the particular practice involved in the cultivation of flax, ramie, and other fibers, cost of production, market, etc., but many are asking where the proper seed can be secured with which to make a start.

The importation of unmanufactured flax, hemp, textile grasses, and other fibers amounts annually to a sum ranging from fifteen million to twenty million dollars, while the imported manufactures of these fibers amount to almost double this value, or, in round numbers, approximately forty-five million dollars. With the establishment and extension of three or four fiber industries in this country, and with the new manufacturing enterprises that would grow out of such establishment and extension, an immense sum could be readily saved to the country, and the money representing the growth of these fibers would add just so much to the wealth of the farming class.

There are two ways in which we may arrive at a solution of this problem: by direct Government aid, and through the intelligently directed efforts of private enterprise.

Government experiments for the development or extension of vegetable fiber industries have been instituted, at different times, in many countries. In some instances these have been confined to testing the strength of native fibrous substances for comparison with similar tests of commercial fibers. Such were the almost exhaustive experiments of Roxburgh in India early in the present century. Another direction for Government experimentation has been the testing of machines to supersede costly hand labor in the preparation of the raw material for market, or in the development of chemical processes for the further preparation of the fibers for manufacture. The broadest field of experiment, however, has been the growth of the plants under different conditions, either to introduce their culture, or to economically develop the industries growing out of their culture, when such industries need to be fostered. The introduction of ramie culture is an example of the first instance, the fostering of the almost extinct flax industry of our grandfathers' days an illustration of the second.

The United States has conducted experiments or instituted inquiries in the fiber interest at various times in the last fifty years, but it is only since 1890 that an office of practical experiment and inquiry has been established by the United States Department of Agriculture, that has been continuous through a term of years.

A COTTON FIELD IN MISSISSIPPI

In the present work the efforts of the Government have been mainly directed in the line of collecting and disseminating authoritative information relating to all branches of the industry, in importing proper seed for experimental cultivation, and in directing experiments, either on its own account or in co-operation with State and even private interests. The testing of new labor-saving machinery has also come within its province.

The subject in its details will be better understood by considering the list of the more important commercial fibers known to our market. The list is not a long one, for it barely reaches a total of fifteen species. The fibers of the first rank are the spinning fibers—namely, cotton, flax, hemp, jute; of the second rank, or cordage fibers, Sisal, Manila, Sunn and Mauritius hemps, and New Zealand flax; and of the third rank, Tampico, or ixtle, African fiber or palmetto, coir or cocoanut, piassaba, Mexican whisk, raffia, and Spanish moss, which are used in brush manufacture, in upholstery, and for other rough manufactures. Of these fifteen forms, only cotton, hemp, palmetto, and Spanish moss are produced in the United States in commercial quantity, though flax line has been produced to some extent in the past. Of those not produced in commercial quantity in this country, but which would thrive in cultivation, may be mentioned jute, New Zealand flax, Sisal hemp, cocoanut, and possibly Sunn hemp in subtropical Florida, with a few "substitutes," which will be mentioned hereafter.

I have neglected to mention in this list the sponge cucumber, a species of *Luffa* used as a bath sponge, which is imported from Japan in quantity, and which grows in the United States.

Passing the list of recognized commercial fibers, we come to a large number of species, forms allied to the above, that are either employed locally, chiefly by the natives in the countries where grown, or that would be capable of employment in the world's manufacture were they not inferior to the standard commercial forms at present recognized, and with which they would necessarily compete at a disadvantage. This list is a long one, for in the single genus *Agave*, to which belong the plant producing the Sisal hemp of commerce, there are over one hundred species in Mexico alone, more than one half of which would produce good fiber. In our own country it would be possible to enumerate twenty species of plants that are recognized as American weeds, the fibers of which could be employed as hemp, flax, or jute substitutes were these materials unobtainable, besides half as many structural fiber plants similar to the agave, the products of which could be employed as cordage fiber substitutes in the same manner. Many of these uncultivated plants have been known to the aborigines for years, possibly for centuries, as we find their fiber, produced in varied forms of rude manufacture, in ancient tombs or other burial places.

Pulling Flax in Minnesota.

After exhausting the list of plants that may be termed commercial fiber substitutes, in different countries where they grow, there still remains a much larger list of species that are chiefly interesting in a scientific enumeration of those plants which produce in their stalks, leaves, or seed vessels what may be termed fibrous substance. My own catalogue of the fibers of the world already foots up over one thousand species of plants, and the complete catalogue for all countries might extend the list to a thousand more.

In considering the undeveloped fibers of the United States, it will be seen we should only recognize the actual commercial forms which we do not produce, but which may be produced within our borders, or such native growths as may be economically employed as their substitutes, and which possibly might be brought into commercial importance.

The hemp industry is already established, though it should be extended in order to recover its lost position among American rural industries. Where in the past we produced forty thousand tons of hemp in the United States, we now produce less than a fifth of this quantity. The cultivation of flax in the United States before the days of the present factory system was so widespread that it was of national importance. Its manufacture was largely a home industry, however, conducted by the fireside, and, as in ancient Greece and Rome, the work was performed by the women of the household. With the advent of the factory system came competition; the housewife laid aside her spinning wheel, the clumsy home-made loom fell into disuse, and the farmer grew no more flax for fiber. Then the flaxseed industry was extended, and after the close of the war a large demand sprang up for coarse fiber for the roughest of uses—for bagging and upholstery, in connection with hemp—and hundreds of little tow mills came into existence in the Middle and Western States.

The introduction of jute opened another chapter, and the decline of this crude attempt at a flax industry is recorded. Meanwhile some line flax was produced, but the extension of spinning and weaving establishments made a larger demand for this fiber, which was chiefly imported. Land in the old flax-growing States became more valuable for other crops, especially with the low prices brought about by foreign competition, and gradually the flax culture in the United States became a thing of the past.

In recent years similar causes have served to operate against the industry in foreign flax countries where old and plodding methods are still in vogue, with additional factors in impoverished soils and high rental for land, and the cultural industry abroad is declining. With the opening of new and fertile Western lands in this country, and with the employment of the finest labor-saving agricultural implements in the world, the conditions are again changed, and are now favorable for American agriculture to re-establish this industry, and to make good a declining foreign supply. Our farmers are ready for the work, but they have not only lost their skill and cunning in producing the straw and preparing the fiber for the spinner, but new and more economical methods must be adopted to place the culture on a solid basis.

A million acres of flax are grown for seed annually, but the growth of flax for seed and flax for fiber are two very different things; moreover, Old World methods do not coincide with the progressive ideas of the educated farmers of the United States, for the peasant class does not exist in this country. A practice essentially American must be followed in order to make the culture profitable, and to equalize the difference in wages on the two sides of the Atlantic. This difference is more apparent than real, for it can be readily overcome by intelligently directed effort, by difference in soil fertility and rentals, and especially by the use of certain forms of labor-saving machines that already have been devised and are being rapidly improved. The "American practice," then, means, first, an intelligent practice, with a view to economy of effort and involving the use of machinery in the place of plodding foreign methods; and, second, the co-operation of farm labor and capital to the end of systematizing the work—i. e., the farmers of a community growing the flax, and capital, represented by a central mill, turning the straw when grown into a grade of fiber that the spinners can afford to purchase. Here is the solution of the flax problem

Hackling Flax.

in a nutshell. The scheme has already been tested in practice with favorable results, but the farmers in any community can do little until capital is more generally interested.

This brings up an important point and presents another obstacle, for great harm has been done to all new fiber industries in recent years by the misdirected efforts of some professional promoters. In certain instances the organized fiber companies have been mere stock-jobbing concerns. They have had their rise and fall, men with idle money have burned their fingers, and the particular industry has received a "black eye."

California Hemp.

The story of Government effort toward the establishment of the flax industry need not be told here; there has been widespread prejudice to overcome, with the opposition of the importers, discouragements to be studied and explained, the unvarnished truth to be told, and practical and authoritative information to be given to all who may seek it. The literature of the subject has been disseminated by thousands of copies, and new editions are being ordered.

As to the results: Superior flax has been produced in this country in limited quantities since the work began, and through extended field experiments flax regions have been discovered that are thought to equal the best flax centers of Europe. The department experiments in the Puget Sound region of Washington have demonstrated that we possess in that State a climate and soil that bid fair to rival the celebrated flax region of Courtrai, and from these experiments scutched flax has been produced that is valued by manufacturers in Ireland at three hundred and fifty dollars per ton, and hackled flax worth five hundred dollars per ton. Much has been done, but a great

Spreading Hemp in Kentucky.

deal more remains to be accomplished in bringing together the farmer and capitalist in the practical work of growing, *retting, scutching, and preparing for market* American flax fiber, for questions of culture are settled.

We should restore our hemp industry to its former proportions by producing high-grade instead of low-grade fiber. The growth of a grade of American hemp that will sell for six to eight cents per pound, instead of three to three and a half cents per pound, as at the present time, means that our farmers must follow more closely the careful practices of Europe, and especially that they must adopt water retting in place of the present practice of dew retting, which gives a fiber dark in color and uneven in quality. A careful consideration of the practices of Italy and France as set forth in Fiber Report No. 11, Department of Agriculture, will materially aid those who desire to change their product from the cheaper dark hemps, for which there is small demand, to the higher-priced light hemps, which will compete with the imported commodity.

One of the most interesting problems of the day in the utilization of the new fiber material, and one that is attracting the attention of all civilized countries, is the industrial production of that wonderful substance known in the Orient as China grass, in India as rhea, and in Europe and America as ramie. They money spent by governments and by private enterprise throughout the world, in experiments and inventions, in the effort to establish the ramie industry, would make up the total of a princely fortune. Obstacle after obstacle has been overcome in the years of persistent effort, and now we stand before the last barrier, baffled for the time, but still hopeful, and with efforts unrelaxed. The difficulty may be stated in a few words: ramie culture will only become a paying industry when an economically successful machine for stripping the fiber has been placed on the market. Hundreds of thousands of dollars have been spent in efforts to perfect a machine, but no Government fiber expert in the world recognizes that we have such a machine at the present time, though great progress has been made in machine construction.

The world's interest in this fiber began in 1869, when a reward of five thousand pounds was offered by the Government of India for the best machine with which to decorticate the green stalks. The first exhibition and trial of machines took place in 1872, resulting in utter failure. The reward was again offered, and in 1879 a second official trial was held, at which ten machines competed, though none filled the requirements, and subsequently the offer was withdrawn. The immediate result was to stimulate invention in many countries, and from 1869 to the present time inventors have been untiring in their efforts to produce a successful machine. The commercial history of ramie, therefore, does not extend further back than 1869.

The first French official trials took place in 1888, followed by the trials of 1889, in Paris, at which the writer was present, and which are recorded in the official reports of the Fiber Investigation series. Another trial was held in 1891, and in the same year the first official trials in America took place, in the State of Vera Cruz, in Mexico, followed the next year by the official trials of American machines in the United States, these being followed by the trials of 1894. Since that year further progress in machine construction has been made, and a third official trial should be held in the near future.


Growth of Jute in Louisiana.

The first records of Chinese shipments of this fiber to European markets show that in 1872 two hundred or three hundred tons of the fiber were sent to London, valued at eighty pounds per ton, or about four hundred dollars. India also sent small shipments, but there was a light demand, with a considerable reduction in price, the quotations being thirty pounds to forty pounds per ton for Chinese and ten pounds to thirty pounds for the Indian product.

Those who are unacquainted with the properties and uses of this wonderful textile may peruse with interest the following paragraph from Fiber Report 7, on the Cultivation of Ramie, issued by the Department of Agriculture:

"The fiber of ramie is strong and durable, is of all fibers least affected by moisture, and from these characteristics must take first rank in value as a textile substance. It has three times the strength of Russian hemp, while its filaments can be separated almost to the fineness of silk. In manufacture it has been spun on various forms of textile machinery, also used in connection with cotton, wool, and silk, and can be employed as a substitute in certain forms of manufacture for all these textiles and for flax also, where elasticity is not essential. It likewise produces superior paper, the fineness and close texture of its pulp making it a most valuable bank-note paper. In England, France, Germany, Austria, and in our own country to an experimental extent, the fiber has also been woven into a great variety of fabrics, covering the widest range of uses, such as lace, lace curtains, handkerchiefs, cloth, or white goods resembling fine linen, dress goods, napkins, table damask, table covers, bedspreads, drapery for curtains or lambrequins, plush, and even carpets and fabrics suitable for clothing. The fiber can be dyed in all desirable shades or colors, some examples having the luster and brilliancy of silk. In China and Japan the fiber is extracted by hand labor; it is not only manufactured into cordage, fish lines, nets, and similar coarse manufactures, but woven into the finest and most beautiful of fabrics."

China is at present the source of supply of the raw product, and the world's demand is only about ten thousand tons, nine tenths of this quantity being absorbed in Oriental countries. The ramie situation in the United States at the present time may be briefly summarized as follows:

The plant can be grown successfully in California and in the Gulf States, and will produce from two to four crops per year without replanting, giving from two hundred and fifty to eight hundred pounds of fiber per acre, dependent upon the number of cuttings, worth perhaps four cents per pound. The machines for preparing this fiber for market are hardly able at the present time to clean the product of one acre (single crop) in a day, and the fiber is quite inferior to the commercial China grass. A new French machine produces a quality of fiber which approaches the China grass of commerce, but its output per day is too small to make its use profitable in this country. All obstacles in chemical treatment of the fiber and in spinning and manufacture are overcome, and the world is waiting for the successful device which will economically prepare the raw material for market.

The part the United States Government is taking in the work is to co-operate in experiments, to issue publications giving all desired information regarding culture, the machine question, and the utilization of the fiber. It tests new decorticators and reports to the public upon their merits or demerits. It cautions farmers and capitalists, for the present, to go into the industry with their eyes open, for the professional promotor has seized upon this industry, above all others in the fiber interest, as one in which he can more readily gull a gullible public. Nevertheless, responsible capitalists are making every legitimate effort to place the manufacturing industry on a solid basis in this country, and to attain to the progress made in other countries where manufacture has already been established, and where the Chinese fiber is employed as the raw material.

Thus far I have only considered spinning fibers. More than one half of the raw fibers imported in the United States are employed

A Florida Sisal Hemp Plant.

in the manufacture of rope and small twine, or bagging for baling the cotton crop. Cordage is manufactured chiefly from the Manila and Sisal hemps, the former derived from the Philippine Islands, the latter from Yucatan. Some jute is also used in this industry, though the fiber is more largely employed in bagging; and some common hemp, such as is grown in Kentucky, is also used.

We can not produce Manila hemp in the United States, and this substance will always hold its own for marine cordage. Jute will grow to perfection in many of the Southern States, but it is doubtful if we can produce it at a price low enough to compete with the cheaper grades of the imported India fiber. Rough flax and common hemp might be used in lieu of jute, in bagging manufacture, but the question of competition is still a factor. Sisal hemp, which has been imported to the value of seven million dollars a year, when prices were high, will grow in southern Florida, and the plant has been the subject of exhaustive study and experiment. This plant was first grown in the United States on Indian Key, Florida, about 1836, a few

Pineapple Field in Florida.

plants having been introduced from Mexico by Dr. Henry Perrine, and from this early attempt at cultivation the species has spread over southern Florida, the remains of former small experimental tracts being found at many points, though uncared for.

The high prices of cordage fibers in 1890 and 1891, brought about by the schemes of certain cordage concerns, called attention to the necessity of producing, if possible, a portion of the supply of these hard fibers within our own borders. In 1891, in response to requests for definite information regarding the growth of the Sisal hemp plant, a preliminary survey of the Key system and Biscayne Bay region of southern Florida was made by the Department of Agriculture, and in the following year an experimental factory was established at Cocoanut Grove with special machinery sent down for the work. With this equipment, and with a fast-sailing yacht at the disposal of the special agent in charge of the experiments, a careful study of the Sisal hemp plant, its fiber, and the possibility of the industry was made, and the results were duly published. About this time the Bahaman Government became interested in the industry, and with shiploads of plants, both purchased and gathered without cost on the uninhabited Florida Keys, the Bahamans *began the new industry* by setting out extensive plantations on the different islands of the group. The high prices of 1890 having overstimulated production in Yucatan, two or three years later there was a tremendous fall in the market price of Sisal hemp, and Florida's interest in the new fiber subsided, though small plantations had been attempted. In the meantime, American invention having continued its efforts in the construction of cleaning devices, two successful machines for preparing the raw fiber have been produced which have, in a measure, superseded the clumsy *raspadore* hitherto universally employed for the purpose, and one of the obstacles to the production of the fiber in Florida is removed. The reaction toward better prices has already begun, and the future establishment of an American Sisal hemp industry in southern Florida is a possibility, though there are several practical questions yet to be settled.

Pineapple culture is already a flourishing industry in the Sisal hemp region. A pineapple plant matures but one apple in a season, and after the harvest of fruit the old leaves are of no further use to the plant, and may be removed. The leaves have the same structural system as the agaves—that is, they are composed of a cellular mass through which the fibers extend, and when the epidermis and pulpy matter are eliminated the residue is a soft, silklike filament, the value of which has long been recognized. Only fifty pounds of this fiber can be obtained from a ton of leaves, but, as the product would doubtless command double the price of Sisal hemp, its production would be profitable. How to secure this fiber cheaply is the problem. The Sisal hemp machines are too rough in action for so fine a fiber, and, at the rate of ten leaves to the pound, working up a ton of the material would mean the handling of over twenty thousand leaves to secure perhaps three dollars' worth of the commercial product. Were the fiber utilized in the arts, however, and its place established, it would compete in a measure with flax as a spinning fiber, for its filaments are divisible to the ten-thousandth of an inch. The substance has already been utilized to a slight extent in Eastern countries (being hand-prepared) in the manufacture of costly, filmy, cobweblike fabrics that will almost float in air.

Another possible fiber industry for Florida is the cultivation of bowstring hemp, or the fiber of a species of *Sansevieria* that grows in rank luxuriance thoughout the subtropical region of the State. The fiber is finer and softer than Sisal hemp, though not so fine as pineapple fiber, and would command in price a figure between the two. The yield is about sixty pounds to the ton of leaves. Many other textile plants might be named that have been experimented with by

A Plant of New Zealand Flax.

the Government or through private enterprise, but the most important, in a commercial sense, have been named.

There is a considerable list of plants, however, which are the subject of frequent inquiry, but which will never be utilized commercially as long as other more useful fibers hold the market. These for the most part produce bast fiber, and the farmer knows them as wild field growths or weeds. They are interesting in themselves, and many of them produce a fair quality of fiber, but to what extent they might be brought into cultivation, or how economically the raw material might be prepared, are questions the details of which only experiment can determine. But the fact that at best they can only be regarded as the substitutes for better, already established, commercial fibers has prevented serious experiment to ascertain their place. They are continually brought to notice, however, for again and again the thrifty farmer, as he finds their bleached and weather-beaten filaments clinging to the dead stalks in the fields, deludes himself in believing that he has made a discovery which may lead to untold wealth, and a letter and the specimen are promptly dispatched to the fiber expert for information concerning them. In such cases all that can be done is to give full information, taking care to let the inquirer down as easily as possible.

The limit of practical work in the direction of new textile industries is so clearly defined that the expert need never be in doubt regarding the economic value of any fiber plant that may be submitted to him for an opinion, and the long catalogue of mere fibrous substances will never demand his serious attention.

In studying the problem of the establishment of new fiber industries, therefore, we should consider "materials" rather than particular species of plants—utility or adaptation rather than acclimatization. We should study the entire range of textile manufacture, and before giving attention to questions of cultivation we should first ascertain how far the plants which we already know can be produced within our own borders may be depended upon to supply the "material" adapted to present demands in manufacture. If the larger part of our better fabrics—cordage and fine twines, bagging, and similar rough goods—can be made from cotton, flax, common hemp, and Sisal hemp, which we ought to be able to produce in quantity at home, there is no further need of costly experiments with other fibers. Unfortunately, however, it is possible for manufacturers to "discriminate" against a particular fiber when the use of another fiber better subserves their private interests. As an example, common hemp was discriminated against in a certain form of small cordage, in extensive use, because by employing other, imported fibers, it has been possible in the past to control the supply, and in this day of trusts such control is an important factor in regulating the profits. With common hemp grown on a thousand American farms in 1890, the price of Sisal and Manila hemp binding twine, of which fifty thousand tons were used, would never have been forced up to sixteen and twenty cents a pound, when common hemp, which is just as good for the purpose, could have been produced in unlimited quantity for three and a half cents. The bagging with which the cotton crop is baled is made of imported jute, but common hemp or even low-grade flax would make better bagging. A change from jute to hemp or flax in the manufacture of bagging (it would only be a return to these fibers), could it be brought about, would mean an advantage of at least three million dollars to our farmers. Yet in considering such a desirable change we are confronted with two questions: Is it possible to compete with foreign jute? and can prejudice be overcome? For it is true that there are, even among farmers, those who would hesitate to buy hemp bagging at the same price as jute bagging because it was not the thing they were familiar with. But

Cabbage Palmetto in Florida.

some of them will buy inferior jute twine, colored to resemble hemp, at the price of hemp, and never question the fraud.

Our farmers waste the fibrous straw produced on the million acres of flax grown for seed. It has little value, it is true, for the production of good spinning flax, yet by modifying present methods of culture, salable fiber can be produced and the seed saved as well, giving two paying crops from the same harvest where now the flax-seed grower secures but one.

In summarizing the situation in this country, therefore, it will be seen that, out of the hundreds of fibrous plants known to the botanist and to the fiber expert, the textile economist need only consider four or five species and their varieties, all of them supplying well-known commercial products that are regularly quoted in the world's market price current, the cultivation and preparation of which are known quantities. Were the future of new fiber industries in this country to rest upon this simple statement, there would be little need of further effort. The problem, however, is one of economical adaptation to conditions not widely understood in the first place, and not altogether within control in the second.

Twenty flax farmers in a community decide to grow flax for fiber, and two of these farmers are perhaps acquainted with the culture. They go to work each in his own way; ten make a positive failure in cultivation for lack of proper direction, five of the remaining ten fail in retting the straw, and five succeed in turning out as many different grades of flax line, only one grade of which may come up to the standard required by the spinners. And all of them will have lost money. If the failure is investigated it will be discovered that the proper seed was not used; in some instances the soil was not adapted to the culture, and old-fashioned ideas prevailed in the practice followed. The straw was not pulled at the proper time, and it was improperly retted. The breaking and scutching were accomplished in a primitive way, because the farmers could not afford to purchase the necessary machinery, and of course they all lost money, and decided in future to let flax alone.

But the next year the president of the local bank, the secretary of the town board of trade, and three or four prosperous merchants formed a little company and built a flax mill. A competent superintendent—perhaps an old country flax-man—was employed, a quantity of good seed was imported, and the company contracted with these twenty farmers to grow five, ten, or fifteen acres of flax straw each, under the direction of the old Scotch superintendent. The seed was sold to them to be paid for in product; they were advised regarding proper soil and the best practice to follow; they grew good straw, and when it was ready to harvest the company took it off their hands at a stipulated price per ton. The superintendent of the mill assumed all further responsibility, attended to the retting, and worked up the product. Result: several carloads of salable flax fiber shipped to the Eastern market in the winter, the twenty farmers had "money to burn" instead of flax straw, and the company was able to declare a dividend. This is not altogether a supposititious case, and it illustrates the point that in this day of specialties the fiber industry can only be established by co-operation.

In all these industries, whether the fiber cultivated is flax, ramie, or jute, the machine question enters so largely into the problem of their successful establishment that the business must be conducted on a large scale. Even in the growth of Sisal hemp in Florida, should it be attempted, the enterprise will only pay when the necessary mill plant for extracting the fiber is able to draw upon a cultivated area of five hundred acres. In other words, the small farmer can never become a fiber producer independently, but must represent a single wheel in the combination.

The Luffa, or Sponge Cucumber.

The subject is a vast one, and, while I have been able to set forth the importance of these industries as new sources of national prosperity, only an outline has been given of the difficulties which are factors in the industrial problem. Summing up the points of vantage, the market is already assured; through years of study and experiment we are beginning to better understand the particular conditions that influence success or failure in this country; we have the best agricultural implements in the world, and American inventive genius will be able, doubtless, in time, to perfect the new mechanical devices which are so essential to economical production; our farmers are intelligent and industrious, and need only the promise of a fair return for their labor to enter heart and soul into this work.

WHAT IS SOCIAL EVOLUTION?

By HERBERT SPENCER.

THOUGH to Mr. Mallock the matter will doubtless seem otherwise, to most it will seem that he is not prudent in returning to the question he has raised; since the result must be to show again how unwarranted is the interpretation he has given of my views. Let me dispose of the personal question before passing to the impersonal one.

He says that I, declining to take any notice of those other passages which he has quoted from me, treat his criticism as though it were "founded exclusively on the particular passage which" I deal with, "or at all events to rest on that passage as its principal foundation and justification." * It would be a sufficient reply that in a letter to a newspaper numerous extracts are inadmissible; but there is the further reply that I had his own warrant for regarding the passage in question as conclusively showing the truth of his representations. He writes:—

> Should any doubt as to the matter still remain in the reader's mind, it will be dispelled by the quotation of one further passage. "*A true social aggregate*," he says ["*as distinct from a mere large family*], *is a union of like individuals, independent of one another in parentage, and approximately equal in capacities*." †

I do not see how, having small liberty of quotation, I could do better than take, as summarizing his meaning, this sentence which he gives as dissipating "any doubt." But now let me repeat the paragraph in which I have pointed out how distorted is Mr. Mallock's interpretation of this sentence.

> Every reader will assume that this extract is from some passage treating of human societies. He will be wrong, however. It forms part of a section describing Super-Organic Evolution at large ("Principles of Sociology," sec. 3), and treating, more especially, of the social insects; the purpose of the section being to exclude these from consideration. It is implied that the inquiry about to be entered upon concerns societies formed of like units, and not societies formed of units extremely unlike. It is pointed out that among the *Termites* there are six unlike forms, and among the Sauba ants, besides the two sexually-developed forms, there are three classes of workers—one indoor and two outdoor. The members of such communities —queens, males, soldiers, workers—differ widely in their structures, instincts, and powers. These communities formed of units extremely unequal in their capacities are contrasted with communities formed of units approximately equal in their capacities—the human communities about to be

* Nineteenth Century, p. 316.

† Aristocracy and Evolution, pp. 52, 53. The italics are his.

dealt with. When I thus distinguished between groups of individuals having widely different sets of faculties, and groups of individuals having similar sets of faculties (constituting their common human nature), I never imagined that by speaking of these last as having approximately equal capacities, in contrast with the first as having extremely unequal ones, I might be supposed to deny that any considerable differences existed among these last. Mr. Mallock, however, detaching this passage from its context, represents it as a deliberate characterization to be thereafter taken for granted; and, on the strength of it, ascribes to me the absurd belief that there are no marked superiorities and inferiorities among men! or, that if there are, no social results flow from them!*

Though I thought it well thus to repudiate the absurd belief ascribed to me, I did not think it well to enter upon a discussion of Mr. Mallock's allegations at large. He says I ought to have given to the matter "more than the partial and inconclusive attention he has [I have] bestowed upon it." Apparently he forgets that if a writer on many subjects deals in full with all who challenge his conclusions, he will have time for nothing else; and he forgets that one who, at the close of life, has but a small remnant of energy left, while some things of moment remain to be done, must as a rule leave assailants unanswered or fail in his more important aims. Now, however, that Mr. Mallock has widely diffused his misinterpretations, I feel obliged, much to my regret, to deal with them. He will find that my reply does not consist merely of a repudiation of the absurdity he ascribes to me.

The title of his book is a misnomer. I do not refer to the fact that the word "Aristocracy," though used in a legitimate sense, is used in a sense so unlike that now current as to be misleading: that is patent. Nor do I refer to the fact that the word "Evolution," covering, as it does, all orders of phenomena, is wrongly used when it is applied to that single group of phenomena constituting Social Evolution. But I refer to the fact that his book does not concern Social Evolution at all: it concerns social life, social activity, social prosperity. Its facts bear somewhat the same relation to the facts of Social Evolution as an account of a man's nutrition and physical welfare bears to an account of his bodily structure and functions.

In an essay on "Progress: its Law and Cause," published in 1857, containing an outline of the doctrine which I have since elaborated in the ten volumes of *Synthetic Philosophy*, I commenced by pointing out defects in the current conception of progress.

It takes in not so much the reality of Progress as its accompaniments—not so much the substance as the shadow. That progress in intelligence seen during the growth of the child into the man, or the savage into the

* Literature, April 2, 1898.

philosopher, is commonly regarded as consisting in the greater number of facts known and laws understood: whereas the actual progress consists in those internal modifications of which this increased knowledge is the expression. Social progress is supposed to consist in the produce of a greater quantity and variety of the articles required for satisfying men's wants; in the increasing security of person and property; in widening freedom of action: whereas, rightly understood, social progress consists in those changes of structure in the social organism which have entailed these consequences. The current conception is a teleological one. The phenomena are contemplated solely as bearing on human happiness. Only those changes are held to constitute progress which directly or indirectly tend to heighten human happiness. And they are thought to constitute progress simply *because* they tend to heighten human happiness. But rightly to understand progress, we must inquire what is the nature of these changes, considered apart from our interests.*

With the view of excluding these anthropocentric interpretations and also because it served better to cover those inorganic changes which the word "progress" suggests but vaguely, I employed the word "evolution." But my hope that, by the use of this word, irrelevant facts and considerations would be set aside, proves ill-grounded. Mr. Mallock now includes under it those things which I endeavored to exclude. He is dominated by the current idea of progress as a process of improvement, in the human sense; and is thus led to join with those social changes which constitute advance in social organization, those social changes which are ancillary to it—not constituting parts of the advance itself, but yielding fit materials and conditions. It is true that he recognizes social science as aiming "to deduce our civilization of to-day from the condition of the primitive savage." It is true that he says social science "primarily sets itself to explain, not how a given set of social conditions affects those who live among them, but how social conditions at one epoch are different from those of another, how each set of conditions is the resultant of those preceding it." † But in his conception as thus indicated he masses together not the phenomena of developing social structures and functions only, but all those which accompany them; as is shown by the complaint he approvingly cites that the sociological theory set forth by me does not yield manifest solutions of current social problems: ‡ clearly implying the belief that an account of social evolution containing no lessons which he who runs may read is erroneous.

While Mr. Mallock's statements and arguments thus recognize Social Evolution in a general way, and its continuity with evolution of simpler kinds, they do not recognize that definition of evolution

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* Westminster Review, April, 1857.

† Aristocracy and Evolution, pp. 5, 7.

‡ Ibid., pp. 10, 11.

under its various forms, social included, which it has been all along my purpose to illustrate in detail. He refers to evolution as exhibited in the change from a savage to a civilized state; but he does not ask in what the change essentially consists, and, not asking this, does not see what alone is to be included in an account of it. Let us contemplate for a moment the two extremes of the process.

Here is a wandering cluster of men, or rather of families, concerning which, considered as an aggregate, little more can be said than can be said of a transitory crowd: the group considered as a whole is to be described not so much by characters as by the absence of characters. It is so loose as hardly to constitute an aggregate, and it is practically structureless. Turn now to a civilized society. No longer a small wandering group but a vast stationary nation, it presents us with a multitude of parts which, though separate in various degrees, are tied together by their mutual dependence. The cluster of families forming a primitive tribe separates with impunity: now increase of size, now dissension, now need for finding food, causes it from time to time to divide; and the resulting smaller clusters carry on what social life they have just as readily as before. But it is otherwise with a developed society. Not only by its stationariness is this prevented from dividing bodily, but its parts, though distinct, have become so closely connected that they can not live without mutual aid. It is impossible for the agricultural community to carry on its business if it has not the clothing which the manufacturing community furnishes. Without fires neither urban nor rural populations can do their work, any more than can the multitudinous manufacturers who need engines and furnaces; so that these are all dependent on coal-miners. The tasks of the mason and the builder must be left undone unless the quarryman and the carpenter have been active. Throughout all towns and villages retail traders obtain from the Manchester district the calicoes they want, from Leeds their woolens, from Sheffield their cutlery. And so throughout, in general and in detail. That is to say, the whole nation is made coherent by the dependence of its parts on one another—a dependence so great that an extensive strike of coal-miners checks the production of iron, throws many thousands of ship-builders out of work, adds to the outlay for coal in all households, and diminishes railway dividends. Here then is one primary contrast—the primitive tribe is incoherent, the civilized nation is coherent.

While the developing society has thus become integrated, it has passed from its original uniform state into a multiform state. Among savages there are no unlikenesses of occupations. Every man is hunter and upon occasion warrior; every man builds his own hut, makes his own weapons; every wife digs roots, catches fish, and carries the household goods when a change of locality is needed: what division of labor exists is only between the sexes. We all know that it is quite otherwise with a civilized nation. The changes which have produced the coherence have done this by producing the division of labor: the two going on *pari passu*. The great parts and the small parts, and the parts within parts, into which a modern society is divisible, are clusters of men made unlike in so far as they discharge the unlike functions required for maintaining the national life. Rural laborers and farmers, manufacturers and their work-people, wholesale merchants and retailers, etc., etc., constitute differentiated groups, which make a society as a whole extremely various in composition. Not only in its industrial divisions is it various, but also in its governmental divisions, from the components of the legislature down through the numerous kinds and grades of officials, down through the many classes of masters and subordinates, down through the relations of shopkeeper and journeyman, mistress and maid. That is to say, the change which has been taking place is, under one aspect, a change from homogeneity of the parts to heterogeneity of the parts.

A concomitant change has been from a state of vague structure, so far as there is any, to a state of distinct structure. Even the primary differentiation in the lowest human groups is confused and unsettled. The aboriginal chief, merely a superior warrior, is a chief only while war lasts—loses all distinction and power when war ceases; and even when he becomes a settled chief, he is still so little marked off from the rest that he carries on his hut-building, tool-making, fishing, etc., just as the rest do. In such organization as exists nothing is distinguished, everything is confused. Quite otherwise is it in the developed nation. The various occupations, at the same time that they have become multitudinous, have become clearly specialized and sharply limited. Read the London Directory, and while shown how numerous they are, you are shown by the names how distinct they are. This increasing distinctness has been shown from the early stages when all freemen were warriors, through the days when retainers now fought and now tilled their fields, down to the times of standing armies; or again from the recent days when in each rural household, besides the bread-winning occupation, there were carried on spinning, brewing, washing, to the present day when these several supplementary occupations have been deputed to separate classes exclusively devoted to them. It has been shown from the ages when guilds quarreled about the things included in their respective few businesses, down to our age when the many businesses of artisans are fenced round and disputed over if transgressed, as lately by boilermakers and fitters; and is again shown by the ways in which the professions—medical, legal, and other—form themselves into bodies which shut out from practice, if they can, all who do not bear their stamp. And throughout the governmental organization, from its first stage in which the same man played various parts—legislative, executive, judicial, militant, ecclesiastic—to late stages when the powers and functions of the multitudinous classes of officials are clearly prescribed, may be traced this increasing sharpness of division among the component parts of a society. That is to say, there has been a change from the indefinite to the definite. While the social organization has advanced in coherence and heterogeneity, it has also advanced in definiteness.

If, now, Mr. Mallock will turn to *First Principles*, he will there see that under its chief aspect Evolution is said to be a change from a state of indefinite, incoherent homogeneity to a state of definite, coherent heterogeneity. If he reads further on he will find that these several traits of evolution are successively exemplified throughout astronomic changes, geologic changes, the changes displayed by each organism, by the aggregate of all organisms, by the development of the mental powers, by the genesis of societies, and by the various products of social life—language, science, art, etc. If he pursues the inquiry he will see that in the series of treatises (from which astronomy and geology were for brevity's sake omitted) dealing with biology, psychology, and sociology, the purpose has been to elaborate the interpretations sketched out in *First Principles;* and that I have not been concerned in any of them to do more than delineate those changes of structure and function which, according to the definition, constitute Evolution. He will see that in treating of social evolution I have dealt only with the transformation through which the primitive small social germ has passed into the vast highly developed nation. And perhaps he will then see that those which he regards as all-important factors are but incidentally referred to by me because they are but unimportant factors in this process of transformation. The agencies which he emphasizes, and in one sense rightly emphasizes, are not agencies by which the development of structures and functions has been effected; they are only agencies by which social life has been facilitated and exalted, and aids furnished for further social evolution.

Respecting the essential causes of this social transformation, it must suffice to say that it results from certain general traits in human beings, joined with the influences of their varying circumstances.

Every man aims to pass from desire to satisfaction with the least possible hindrance—follows the line of least resistance. Either the shortest path, or the path which presents fewest impediments, is that which he chooses; and the like applies to courses of conduct at large: he does not use great effort to satisfy a want when small effort will do. Given his surroundings and the occupation he chooses, when choice is possible, is that which promises a satisfactory livelihood with the least tax on such powers as he has, bodily and mental—is the easiest to his particular nature, all things considered. What holds of individuals holds of masses of individuals; and hence the inhabitants of a tract offering facilities for a particular occupation fall into that occupation. In § 732 of the *Principles of Sociology* I have given from various countries illustrations of the ways in which local conditions determine the local industries:—instance among ourselves mining districts where there are coal, ironstone, lead, slate; wheat-growing districts and pastoral districts; fruit and hop districts; districts for weavers, stockingers, workers in iron; places for ship-building, importing, fishing, etc.: showing that certain sections of the population become turned into organizations for the production of certain commodities, without reference to the directive agency of any man. So in each case is it with the various classes of merchants, shopkeepers, professional men, etc., who in each of these centers minister to those engaged in its special industries: nobody ordering them to come or to go.

Similarly when we pass from production to distribution. As in India at the present time, where a Juggernaut festival is accompanied by a vast fair; as, according to Curtius and Mommsen, in Greece and Rome, the gatherings of people to make sacrifices to the gods were the occasions for trading; so in Christian times, church festivals and saints' days, drawing assemblages of people for worship, led to active exchange of commodities—the names of the fairs proving their origin. This was not arranged by any one: it arose from the common sense of all who wanted to sell some things and buy others. There has been a like history for the rise of markets, and the transition from weekly to bi-weekly, and finally to daily, markets in respect of important things—corn, money, securities. No superior man, political or other, dictated these developments. When barter gave place to exchange by means of a currency, the like happened. One wanting to dispose of surplus goods, meeting those who had no personal need for such goods, took in exchange certain things in universal demand, which he knew he would be able to pass on in like manner—in early stages articles of food, of warmth, of defense, of ornament; and from such articles arose in each case a currency—here dried fish, there tea-bricks, and in other cases skins, bundles of cotton, here standard bars of rock salt, there standard bars of iron, in one place definite lengths of cloth, and in another fine mats, and in many places ornaments and the materials for ornaments: which last, gold and silver, being relatively portable, passed into wide use. These precious metals were at first in quantities actually weighed; then in quantities of professed weight; and finally in quantities bearing the king's stamp as being the most trustworthy. No great man—political, industrial, or other—invented this system. It has everywhere resulted from men's efforts to satisfy their needs in the easiest ways. So was it with the transition from a currency of intrinsic value to one of representative value. When, instead of a direct payment in coin, there came to be used a memorandum of indebtedness to be presently discharged, which could be transferred to others—when, as in Italy, to save the weighing and testing of miscellaneous coins, there arose the practice of depositing specified quantities with a custodian and having from him negotiable receipts—when, as in England, the merchants, after having been robbed by the king of their valuables, left for security in the Tower, sought safer places, and, depositing them in the vaults of goldsmiths, received in return "goldsmiths' notes," which could pass from hand to hand; there was initiated a paper-currency. Goldsmiths developed into bankers; after central banks there arose provincial banks; promises to pay became to a great extent substitutes for actual payments; and presently grew up the supplementary system of checks, extensively serving in place of coin and notes. Finally, bank-clerks in London, instead of presenting to the respective banks the many and various claims upon them, met and exchanged these claims and settled the balance: whence presently came the clearing house. No superior man arranged all this. Each further stage was prompted by the desire to economize labor. From primitive fairs up to the daily transactions of the money market, distribution and exchange have developed without the dictation of any great man, either of Mr. Carlyle's sort or of Mr. Mallock's sort. It has been so throughout all other arrangements subserving national life, even the governmental. Though here at least it seems that the individual will and power play the largest part, yet it is otherwise. I do not merely refer to the fact that without loyalty in citizens a ruler can have no power; and that so the supremacy of a man intrinsically or conventionally great is an outcome of the average nature; but I refer to the fact that governmental evolution is essentially a result of social necessities. On tracing its earliest stages from savage life upwards, it becomes manifest that even a ministry is not the mere invention of a king. It arises everywhere from that augmentation of business which goes along with increase of territory and authority: entailing the necessity for deputing more and more work. Under its special aspect it seems to be wholly a result of the king's private action, but under its general aspect it is seen to be determined by the conditions of his existence. And it is so with governmental institutions at large. Without tracing these further it will suffice to quote the saying of Macintosh—"Constitutions are not made but grow."

Of course inequalities of nature and consequent inequalities of relative position are factors in social changes. Of course, as implied above, any assertion of the approximate equality of human beings, save in the sense that they are beings having sets of faculties common to them all, is absurd; and it is equally absurd to suppose that the unlikenesses which exist are without effects on social life. I have pointed out that in the earliest stages of social evolution, when war is the business of life, the supremacy of a leader or chief, or primitive king, is a fact of cardinal importance; and also that the initiator of ecclesiastical control is necessarily distinguished from others "by knowledge and intellectual capacity." The beginnings of industrial evolution are also ascribed by me to differences of individual capacity; as instance the following quotations from that part of the *Principles of Sociology* which deals with Industrial Institutions.

The natural selection of occupations has for its primary cause certain original differences between individuals, partly physical, partly psychical. Let us for brevity's sake call this the physio-psychological cause (§ 730).

That among the fully civilized there are in like manner specializations of function caused by natural aptitudes, needs no showing: professions and crafts are often thus determined . . . occupations of relatively skilled kinds having fallen into the hands of the most intelligent (§ 731).

Speaking generally, the man who, among primitive peoples, becomes ruler, is at once a man of power and a man of sagacity: his sagacity being in large measure the cause of his supremacy. We may therefore infer that as his political rule, though chiefly guided by his own interests, is in part guided by the interests of his people, so his industrial rule, though having for its first end to enrich himself, has for its second end the prosperity of industry at large. It is a fair inference that on the average his greater knowledge expresses itself in orders which seem, and sometimes are, beneficial (§ 770).

In its beginnings slavery commonly implies some kind of inferiority (§ 795).

Considered as a form of industrial regulation, slavery has been natural to early stages of conflicts and consolidations (§ 800).

The rise of slavery exhibits in its primary form the differentiation of the regulative part of a society from the operative part (§ 798).

The recognition of these effects of individual differences, especially in early stages, may rightly go along with the assertion that all the large traits of social structure are otherwise determined—that all those great components of a society which carry on the various industries, making the life of the whole possible, all those specialized classes which have established and maintained the inter-dependence of the producing structures, by facilitating and regulating the exchange of their products, have arisen from the play of aggregate forces, constituted of men's desires directed by their respective sets of circumstances. Mr. Mallock alleges that the great fact of human inequality—the fact that there is a minority "more gifted and efficient than the majority"—is the fundamental fact from which "the main structural characteristics of all civilized societies spring."* That he should assert this in presence of all the evidence which the *Principles of Sociology* puts before him, is, to use the weakest word, surprising. If his assertion be true, however, the way of demonstrating its truth lies open before him. In volumes II. and III. of the *Principles of Sociology*, several groups of institutions, presented by every developed society, are dealt with under the heads, Political, Ecclesiastical, Professional, Industrial: seventy-one chapters being included in them. Each chapter treats of some aspect, some division or subdivision, of the phenomena grouped under the general head. Instead of the Industrial Institutions discussed above, suppose that Mr. Mallock takes a group not touched upon—Professional Institutions. The thesis worked out in the part so entitled is that all the professions are differentiated from the priesthood; and the differentiation is tacitly represented as due to the slow operation of those natural causes which lead to specializations of function throughout the whole social aggregate. If Mr. Mallock is right, then of the chapters dealing with the ten professions enumerated, each is wrong by omitting to say anything about the great man, political, industrial, or other, who set up the differentiation or from time to time consciously gave it a more pronounced character—who thought that it would be well that there should be a separate medical class, or a separate teaching class, or a separate artist class, and then carried his thought into effect. Mr. Mallock's course is simply to take each of these chapters and show how, by the recognition of the supplementary factor on which he insists, the conclusions of the chapter are transformed. If he does this he will do more than by merely asserting that my views of social evolution are wrong because the "great fact of human inequality" "is systematically and ostentatiously ignored."

If in his title Mr. Mallock had, instead of "Evolution," written Social Sustentation, the general argument of his book would have been valid. If, further, he had alleged that social sustentation is

* Nineteenth Century, pp. 314, 315.

instrumental to social evolution, and that in the absence of processes facilitating social sustentation social evolution can not take place, no one could have gainsaid his conclusion. And if he had inferred that whoever improves these processes betters the conditions which favor social evolution, his inference would have been true. But this admission may be made without admitting that the men who directly or indirectly further sustentation, or who improve the quality of the social units, are the agents who determine and direct social evolution. An account of their doings in no way constitutes an account of that social transformation from an indefinite incoherent homogeneity to a definite coherent heterogeneity, in which the evolution of a society essentially consists.

Moreover Mr. Mallock is justified in contending that the great man—discoverer, inventor, teacher, administrator, or other—may equitably receive all the reward which, under the principle of contract, flows to him as the result of his superiority; and that disregard of his claim by the mass of men is alike inequitable and ungrateful. This is the position I have myself taken, as witness the following:—

> Even were an invention of no benefit to society unless thrown open to unbought use, there would still be no just ground for disregarding the inventor's claim; any more than for disregarding the claim of one who labors on his farm for his own benefit and not for public benefit. But as it is, society unavoidably gains immensely more than the inventor gains. Before he can receive any advantage from his new process or apparatus, he must confer advantages on his fellow men—must either supply them with a better article at the price usually charged, or the same article at a lower price. If he fails to do this, his invention is a dead letter; if he does it, he makes over to the world at large nearly all the new mine of wealth he has opened. By the side of the profits which came to Watt from his patents, place the profits which his improvements in the steam-engine have since brought to his own nation and to all nations, and it becomes manifest that the inventor's share is infinitesimal compared with the share mankind takes. And yet there are not a few who would appropriate even his infinitesimal share! *

Had Mr. Mallock recognized the fundamental distinction I have pointed out between social sustentation, life, activity, enlightenment, etc., on the one hand, and the development of social structures on the other, his polemic against socialists and collectivists would have been equally effective, and he would not have entailed upon me an expenditure of time and energy which I can ill spare.—*The Nineteenth Century.*

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* Justice, pp. 110, 111.

THE TORRENTS OF SWITZERLAND.

By EDGAR R. DAWSON, M. E.

MARK TWAIN once said that he was in constant expectation in Switzerland of seeing a farmer fall out of his farm. The farmer has in many cases appreciated his hazardous position when harvesting his crops, and has put on crampoons to prevent a precipitous trip into the valley below. The crampoons prevent the farmer leaving his farm in such an undignified manner, but they do not prevent that same farm leaving its position on the mountain side. To show how, in many cases, the mountain sides are kept intact is the object of this paper. The old simile, "I am as sure of it as of the ground on which I stand," would be as much out of place in some parts of Switzerland as in those parts of the world where earthquakes are endemic. In fact, in these latter places, though the surface may receive a good shaking, it generally returns to somewhat the same neighborhood after its nervous peregrinations are over. Not so with the Swiss mountain side. When part of the mountain takes leave of the rest, it is forever.

Switzerland is often spoken of somewhat derisively as a garden, so perfectly have its pleasure grounds been laid out, and so completely comfortable does one find one's self in the midst of Nature's grandeurs. If its water courses had not been controlled and cared for as are those of a well-conducted park it would be chaos! The constant and vigilant struggle the Swiss have been forced to maintain against the liquid element is much to their credit, for they have generally been victorious. They have spent enormous sums of money in keeping their torrents and rivers within reasonable limits, and are even now, at times, forced to suppress new insurrections on the part of these irresponsible agents. The corrections of the water courses have been necessary for several reasons. In the first place, the erosions on the mountain sides result in deposits which present different inconveniences, of which I shall speak later. In the second place, the erosions are frequently the cause of landslides. The work of regulating the action of the water courses is now done according to accepted rules based on experience and on theories which have been confirmed by facts. Years ago, before the confederation took charge of this matter, it was done often in a haphazard, empirical fashion by the local authorities, with or without the aid of an engineer. But some great disasters in the canton of Grisons awakened the people to what might occur to many of them who had hitherto been more fortunate. At the end of September, 1868, both slopes of the Alps, and particularly the cantons of Valais and

Grisons, were visited by floods of enormous magnitude. Such was the devastation caused that an appeal was made to the generosity of the nation at large in behalf of the sufferers. This was responded to with such liberality that a large portion of the sum subscribed was put aside for the purpose of improving the water courses permanently. The fact that collective action was necessary in the attempts to control the turbulent streams became very apparent. This being the case, the state was called upon to take charge of this colossal enterprise. In July, 1871, by federal decree, the confederation declared that the correction and extinction of torrents was a matter of public utility, and worthy of the subsidies of the national Government. At the same time the relative burdens of the cantons and the confederation were settled. The importance of the improvement of the water courses and of the wooding of the regions where they rise was recognized in the Constitution of 1874. There the matter was definitely put under federal control and classed with the allied question of the conservation of the forests. The problem of keeping the waters under control in Switzerland ranges from the marshy lowlands to the summits of the passes. In spite of the varying conditions that this range entails, there are certain general principles that bear on all cases where the water is in movement. As the Swiss supplies his want of coal by harnessing his streams, so he makes the water do a large share of the work of correcting its erring ways and preparing itself to be harnessed. This he does by utilizing its power of carrying or depositing stones and soil, according as it is held within narrow banks or allowed to roam at will. As this power depends also on the steepness of the slope down which it runs, he uses this latter factor as well.

When he has got the water courses into what he considers good working condition and one that should be permanent, he tries to clinch matters. This is done by so combining the various conditions of cross-section, slope, and quality of soil that the action of the water is automatic—that is, it brings down no more earth and stones than it is capable of carrying below to safer places where the dangers of floods are small. Whenever the force with which the water moves along is stronger than the cohesion of the soil, erosion occurs. This erosion will continue, the channel of the stream becoming ever deeper, until a soil is encountered whose resistance is equal to the erosive action of the water. As the alluvion is carried on, the slope of the stream will become steeper and steeper the higher one goes. This circumstance would be of much greater importance if the gorges and gullies in which most of the streams run were not so well provided with rock. The power of the water to cause erosion is lessened in proportion to the amount of material it is carrying with it, which material is generally the product of previous erosions. Whenever the current needs all its strength to carry the material it has in suspension, together with the solid matter it is pushing along, it will have lost all its power to cause erosion. If the slope is decreased, or if the matter in suspension is increased in any manner, deposits will occur. These deposits render the slope less steep at that point but steeper below, so that the action of the water beyond will make itself felt, and by digging gradually up stream tend to restore the original slope.

In some cases there is very little erosion where the current is much stronger than the cohesive power of the soil, for the reason that the beds of the streams have been almost paved with stones that have been carried along by the propulsive action of the water.

This has in many cases produced an equilibrium between the resistance and the destroying power; in others the equilibrium has been brought about in a different way by the same natural agents. The current of a stream will very often go on causing erosion until arrested by some rocky obstacle that determines a waterfall. These falls cause breaks in the action of the water not only in stopping the erosive action in its upward march, but also in checking the velocity of the water. Then, as basins are often formed just above the falls and where the current is much less swift, matter in suspension is deposited, so that when the stream is swollen it has material to work upon, before starting to make the original slope steeper.

The subject divides itself broadly into two branches—the extinction of torrents and the correction of the water courses in valleys. In the extinction of the torrents various plans are resorted to, which give the current greater propulsive power, but at the same time they render necessary greater protection of the bed. This may be done by incasing it within walls of masonry (though other materials are used in some cases) or shortening meandering portions. In the latter plan the slope is increased, the fall being the same for a shorter distance. Currents that have been making dangerous deposits at certain points and causing dangerous erosions at others are treated by the above systems until the danger has disappeared or the money has given out. When the erosive action of the water is already too great, the material carried and then deposited by the stream is often made use of to consolidate banks that are threatened. Spurs are built out from such banks, and this tends to mend matters not only in forcing the water to take another channel, but also in causing deposits at the foot of the menaced bank.

The destructive effects of the current are arrested when the streams are not important by means of dams made of trunks of trees and wooden stakes, often strengthened roughly with stones. Where the streams are larger, and where the erosive action can not be modified by enlarging the channel, as is the case in many gorges, it is necessary to make an artificial bed for the stream and at times to supplement this by masonry dams. The dams are not permanent in their effects, for as soon as the basin immediately above the dam has been filled with deposits and the original slope of the stream has re-established itself, the products of the erosion pass over the dam. They prove, however, of great utility at times of large freshets by causing deposits which are subsequently carried down in much smaller quantities. This prevents the disasters that would be caused by sudden enormous deposits when the streams are swollen.

The prospect for many a narrow valley would be a sad one indeed if means had not been taken to prevent the lateral erosions so common with the mountain torrents and so productive of landslips. Where the stream has provided itself with a stony bed on which to roll, it often tries to do damage by leaving the stones and attacking the earthy banks. It is in these cases that the danger has proved so insidious; for until disasters actually occurred, in many instances, the undermining effect of the water was not suspected, being entirely hidden from view.

The most economical way of combating such cases is by making use of those points that by their formation arrest the erosive action. This is done by re-enforcing them in such manner as to produce a series of natural steps. The upward march of the excavating action of the water is stopped at least partially and temporarily at each step. Such a method is of great advantage when it is necessary to delay a more costly correction for financial reasons.

The experience gained since a connected system was begun in the management of the water courses has been of incalculable value, and many have been the landslips arrested and prevented by seeking their causes in the hidden erosive action of a small stream. In still another manner does the water threaten the mountain sides, and that is by permeating the soil (which is thus rendered much heavier), until it reaches a bed of rock or other layer that it can not penetrate. There it forms a layer of slippery mud on which the soil above slides bodily down. The method pursued in such cases is sometimes that of a ditch dug to the impermeable layer, sometimes that of a drain. In both cases there may or may not be small feeding ditches. Another plan which appears very contradictory of what has just been said is also employed. This consists in preventing, by means of horizontal trenches, the water from flowing off on the surface in the regions above the timber line. The water is forced to percolate through the soil and so reaches the wooded portions, where it would permeate anyhow, much more gradually than otherwise. The soil thus escapes the enormous increase of pressure due to the sudden absorption of great quantities of water, and consequently is less in danger of leaving its fastenings.

One of the most difficult of the problems that these torrents give rise to is that of their control where they suddenly enter a valley, and where the slope is consequently greatly decreased. The decrease of current entailed causes the deposit of stones and material at the mouth of the gorge, and the water then spreads itself over the valley. This occurs more or less regularly with certain torrents that are usually dry and where it is impracticable to prevent the erosions above. It then becomes necessary to build a stone canal from the mouth of the gorge to the principal water course of the valley. As this must be built on the alluvion (which presents the surface of a cone), it is often higher than the rest of the valley, and one may find other small canals for the draining of the valley passing under the larger one and meeting the principal stream below. A similar action to that of the torrent on entering the valley is that of a stream with a rapid current emptying into one whose current is slower. Here the deposits will at times force the smaller stream to seek another channel, and it frequently occurs that the correction moves the mouth of the stream a considerable distance.

The manner in which the streams in the valleys are made to aid in their own correction is most interesting. Whereas in the mountains it is usually desirable to decrease the erosive action of the water, in the valleys the contrary is the case, as the deposits in the lowlands are as dangerous to life and property as was their abstraction above. The great desideratum to be attained is to have the mountain streams arrive in the valleys in a purely liquid condition, and to give the valley streams the power to carry to the lakes any material they may be so unfortunate as to have taken in charge. To accomplish this latter purpose, the sinuosities of the streams are often reduced to straight lines, an increase of slope being thus secured. The new channels are made of a cross-section to enable the water to carry on its alluvion and silt. Where great freshets occur it is necessary to guarantee the artificial beds against the enormous increase of the water's destructive action.

The usual plan is that of having the cross-section of the stream with a deep depression in the center. This depression is of dimensions to insure a proper flow under ordinary conditions. When the stream becomes swollen it overflows the borders of this depression and spreads over a much larger area until the banks proper are encountered. This sudden increase of cross-section reduces the velocity of the water and consequently its destructive power. When the water of a stream is turned from its old channel into the new one that has been prepared for it, the operation is generally very gradually performed, so as to enable the water to fill up the old bed as much as possible by depositing its silt.

A plan pursued with much success is that of building out from the high bank of a stream (which it is desired to confine into a narrower channel) insubmersible spurs, stopping at the points where the new bank is to be situated. The water flowing in between these spurs deposits its dirt and gravel, and gradually builds up the new bank. In many cases the ends of the spurs are connected by low artificial banks of masonry over which the water flows. These banks retain and protect the deposits, and, when the latter have attained a sufficient depth, the artificial banks are raised to their permanent height. Still another method pursued with the same object in view is that of starting up stream and building the banks to their permanent height until a point is reached where it is desired to "fill." Here the artificial banks are left temporarily very low. The water overflows them, and the reduction of its velocity entails the deposit of its silt. When this has continued as long as necessary or practicable, the walls are raised to their permanent height along the section and the same process is repeated below. This gradual process is also very advantageous from a financial point of view. When the engineer finally reaches the mouth of the stream at one of the lakes, we should expect to find his difficulties at an end, as the lakes are usually so deep that the alluvion makes little impression on them, and their areas are such that floods are not much to be feared. But he is confronted here with a new difficulty, that of anchoring or securing the foundation of his artificial river bank. The soil is generally alluvial over a large area, and is very damp. He generally has to terminate the masonry before he reaches the less stable alluvial soil and continue the structure by means of wooden material, which retains its position much better under such circumstances and is more cheaply replaced. It would be natural to imagine that man's control of the water problem stops at this point. But not so with the Swiss; he even controls its exit from some of the lakes. This is notably the case at Geneva, where by means of ingenious dams the lake is maintained at what is deemed a proper level. When it is remembered that this lake is fifty miles long by ten broad, an idea is gained of the amount of water controlled. Every few years the level is lowered for a given period, so that repairs may be made to the walls and structures along the shores.

THE EVOLUTION OF COLONIES.

By JAMES COLLIER.

V.—POLITICAL EVOLUTION.

THE law that the evolution of a colony repeats the evolution of the parent state would here be logically applied to the history of the relations between colonies and the mother country. These would be shown to have followed a similar course, though with new developments, to those of the mother country with *her* suzerain; and they would be carried further back and deeper down to those universal animal processes of lactation and rearing which they continue and which explain them. The gradual settlement of a new country would next be exhibited as a repetition (with necessary modifications) of the settlement of the mother country, because guided by the same general laws—that it dispossesses an earlier race, which had followed quadrupeds and birds, which had followed trees, shrubs, and grasses, which again had sown themselves along geographical lines. Chapters on both topics are unavoidably omitted. The law has now to be applied to the political, industrial, and social evolution of colonies. In so wide a subject only *aperçus* are possible.

There are traces in several colonies of a state anterior to the establishment of a settled government. According to the unloving Hobbes, such a state is necessarily one of war, and it is sometimes that; according to the humane Rousseau, it is one of peace, and, to the credit of human nature, it is oftener that. There were English settlers in Pennsylvania before the Swedes arrived. The first immigrants to Plymouth found predecessors on the coast who owed no allegiance. Seventy years after the foundation of North Carolina the inhabitants still led the lives of freemen in the woods. Prior to 1702 New Jersey was considered one of those provinces "where no regular government had been established." The Tasmanian farmers who colonized Victoria lived for some time without any form of government, and lived peacefully. Pastoralists were found on the Canterbury plains before the advent of the Pilgrims, and were content. When the Pilgrims got into collision with the central government, they said bitterly that they would do better with none. Where it is otherwise the circumstances are exceptional. Gold and silver fields everywhere are at first, and often to the last, scenes of wild disorder, where a man's safety depends on his ability to defend himself. Escaped Australian convicts, runaway sailors, adventurers, and natives made up a community which turned the natural paradise of the Bay of Islands into an earthly hell. Parts of Texas in very recent days were the seat of anarchy. Government soon arrives on the spot in the shape of the Texas Rangers, the Draconian gold-fields mounted police, or a royal governor. Or an organized body of immigrants absorbs previous settlers and evolves from within itself all the agencies of government. On one or other of these two types all colonial societies have been built up. The patriarchal theory of Filmer is realized in those colonies—the great majority—where the government is clothed with power delegated by the sovereign of the mother country. The socialist theory of Locke is embodied in the New England colonies; in the Carolina "Association" of 1719; in the resolutions of the Liberal Association of Canada in 1841, which issued in the compact between the crown and the Canadian people; in the New Zealand whalers in 1840, governed by their own laws; in the New Zealand Company's settlements (with a social contract previously drawn up by the passengers, as by those of the Mayflower); and in the colonies of Otago and Canterbury, and New Australia in Paraguay. Two intermediate groups have a transitional existence. Many colonies have been founded by commercial companies whose collective history might be written in two lines—inception of vast enterprises, partial commercial success, great collateral benefits, ruinous loss of capital, surrender of charter to the crown. A set of colonies peculiar to the United States were established by one or more proprietaries, from whose voluntary concessions the form of government was derived, but most of these merged, after a series of conflicts, in the popular group. They were respectively bastard royal and bastard charter colonies.

From the origin of a colony is deducible its whole political and social structure. Colonies of royal foundation, by a kind of moral pangenesis, tend to reproduce all parts of the mother country that are suitable to the new environment—its inequalities of *rank*, governors who are the image of the sovereign, an executive, legislative, and judicature that are the delegation of his authority. But these institutions must grow; they can not be made. The attempt to create an aristocracy in Carolina, and the proposal to manufacture one in New South Wales, necessarily failed. Yet in both countries one grew or is growing up. In the South there was an untitled aristocracy, with the aristocratic temper, exclusive institutions, and four distinct classes (the descendants of the lords of the manor, villeins or tenants, bond-servants, and slaves, who had a brief existence in Virginia, Carolina, and Maryland)—planters, overseers, mean whites, and negro slaves; the fall of Richmond saw the happy ending of all that. In the British colonies, as in England, there is an increasing passion for titles, and of about sixty grades in the Byzantine hierarchy of the English monarchy at least eleven have been transplanted to colonial soil. But it is on one condition, abroad as at home—

that honor shall be divorced from power. In England the nobliity is being edged out of office, and on Lord Salisbury's grave might be written, "The last of the nobles"—the last who governed his country. In her colonies one premier after another resolutely refuses the forbidden dignity that would banish him from the ministerial Eden. The same point has been reached in the United States from the opposite side. Most of the charter and some of the proprietary colonies developed into republican societies, with political equality as their badge, a popular legislature, an elected judiciary, and a half-elected executive. Side by side with this democracy of power there has grown up in the great cities—Philadelphia, Boston, New York—an aristocracy of blood, culture, or dollars. This aristocracy of fashion—as in France and England, so in the United States and (on a small scale) in Australia—consoles itself for lifelong exclusion from public affairs by addicting itself to literature, art, philanthropy, and such like. But these are only its recreations. Its chief use is to exist, to exhibit the civilization of a people at its flower, to give pleasure to others and to itself. The proportion of this element to the rest of the population will measure the age of the community.

The core of the *executive* is the governor. The governor of the monarchical colonies is the deputy of the sovereign, and the story of his authority is the story in brief of the royal prerogative. The governors of the Spanish colonies arrogated and abused a power far more despotic than a Spanish king's. The French Governor of Illinois ruled with absolute sway. The first Governor of New South Wales exercised unparalleled powers. He could inflict five hundred lashes and impose a five-hundred-pound fine; could sentence to death, execute, or pardon. He regulated trade. He fixed prices, wages, and customs duties. All the labor in the colony was at his disposal. He could bestow grants of land. He appointed to all offices of honor or emolument. The administration of justice was exclusively in his hands. The colonists were his subjects. He was practically irresponsible. Thus an Anglo-Saxon community can take on the characters of an Oriental satrapy. It can also become a military despotism. For some years after the departure of one governor and the deposition of another the government of the colony was in the hands, or under the feet, of the officers of the New South Wales Corps, who ruled it as the Sultan rules Turkey. The stage of pure absolutism, which is necessitated in a colony, as in the mother country, by the existence of a small band of immigrants in the midst of a hostile indigenous population, or of a small number of free settlers among a convict populace, is succeeded by that of limited absolutism. The authority of the governor is checked by the appointment of a council. Most of the early North American crown colonies were at this stage. It answers to England under the later Tudors, and, as there, left ample scope for oppression. Occasionally it blossomed or withered into prodigies of tyranny on a small scale, as in the too celebrated Andros. Sir James Craig, so lately as the beginning of the nineteenth century, treated his Canadian Parliament as superciliously as a Stuart. In New Zealand there were continual complaints that a certain governor had more absolute power than a sovereign. In South Australia and South Africa the same governor ruled like an emperor, his council not thwarting but aggrandizing his authority. This second preconstitutional stage is often unduly prolonged in colonies, as it commonly is in the mother country, on the pretext of an enemy on the frontier or of troubles with the natives, but really because of the forceful character of a governor who is unwilling to lay down the dignity he may not have been overwilling to take up. Its persistence in the North American colonies can only be explained on Haeckel's principle that the development of ancestral species is followed in the development of the embryo. Despotism in the Old World was the parent of despotism in the New. There is no other reason why colonies ripe for self-government, like Massachusetts, New York, and Virginia, should have been oppressed by such men as Andros, Cornbury, and Harvey. The stage is ended by the granting of a constitution or by a successful rebellion. The governor's personal force will then be the measure of his power. The sagacious and resolute Lord Elgin asserted that he had twice the authority in constitutional Canada that he had enjoyed in Jamaica. Such a governor is the colonial analogue of Queen Victoria, who, in consequence of her association with the Prince Consort, the length of her reign, and her strong character, has prolonged monarchical influence. But the day of such sovereigns is passing; the day of such governors is past. The office is by no means shorn of its prerogatives. The governor, like the sovereign, selects his prime minister, and the act may have serious consequences; the appeal of the minister for election as leader by his party shows the blending of the popular with the monarchical strain, but it is little more than formal. As George III in 1783, and William IV in 1834, arbitrarily dismissed the Whigs, a Governor of Newfoundland in 1861 dismissed his ministry; in 1858 the Governor of New South Wales had resolved to dismiss his; and it is not many months since Mr. Rhodes was cashiered. Like the sovereign, the governor sometimes refuses to grant a dissolution. Like the Governor General of Canada last year, or the Governor of New Zealand a few years ago, he may refuse to appoint senators—successfully in the one case or only to be bowled over by the Colonial Office in the other. Beyond these real but rarely exercised prerogatives he has little else to do than sign his ministers' documents. He ought to interfere in certain cabinet crises, but dares not. His power, like that of the sovereign, is reduced to a shadow. The premier of the colony is now its working king.

As the governor's authority wanes, his dignity waxes. After 1632 a viceroy of high rank was sent to New Spain. In 1867 Disraeli, half genius and half charlatan, commenced a policy of ostentation by announcing that only those would in future be appointed colonial governors who had been "born in the purple," or were peers, and notwithstanding two or three Liberal reactions the policy has been confirmed, in regard to all the more important colonies, by the demands of the colonists. On arriving in his dominions the new ruler has a royal reception. He becomes the head of the ceremonial system in the colony, and if he ceases to govern he reigns (according to Bagehot's theory of the monarchy) by impressing the popular imagination. And as loyalty to the Queen is passing into loyalty to the imperial tradition, so is loyalty to her representative being transmuted into the pride of imperial connection.

The governor completes the parallel with sovereignty by undergoing all its vicissitudes. As monarchs have abdicated, been imprisoned, banished, restored, tried, and beheaded, colonial governors have resigned, been imprisoned, expelled, recalled, restored, impeached, dismissed, and hanged, and in both sets of cases for similar reasons. They have resigned because of ill usage at the hands of their ministers, because things were done in their absence of which they disapproved, or because they were entrapped into approving of their ministers' wrongdoing. La Bourdonnais was sent to the Bastille, Andros was imprisoned for tyranny in Massachusetts, and in North Carolina it was the "common practice" to resist and imprison their governors. Depositions were frequent in the North American colonies. An oppressive Governor of Virginia was banished to England, but sent back; a Governor of New South Wales was deposed for rectitude by a military mutiny and shipped to Tasmania; a Governor of New Zealand was placed on board a ship for England because he had excited the ill will of a powerful company, and had indiscreetly realized the dream of free traders by making the colony a free port. As Pericles dreaded being ostracized, early Governors of New South Wales feared being placed under arrest. Recall is the sentence that governors of British colonies had most to shun in the days when they were still irresponsible. The first four Governors of Australia, and possibly the sixth, were lied out of office. One was recalled because of the financial embarrassments of his colony and his own devotion to science; another, on the better grounds of tyranny and red tape. A Governor of the Cape of Good Hope was recalled because he was unpopular. Another governor of that colony was recalled for incorrigible insubordination, and again, when he had been pardoned and sent to a more distant colony, for hopeless incompatibility. How so serious a step may be contrived by a mere clerk in the Colonial Office may be read in the autobiography of Sir Henry Taylor, who procured the recall of an obnoxious governor by submitting to a compliant Secretary of State a dispatch recalling him. An outbreak of public indignation, like that against Governor Eyre, may be needed to bring about the same result. Dupleix and Frontenac fell before the machinations of their enemies, and the former was allowed to die in misery. Hastings was impeached. Articles equivalent to impeachment were drawn up against a Governor of New South Wales, who, like Clive, suffered the indignity of having his administration scrutinized by a committee of the House of Commons. Lastly, as a single English king was brought to the block, so has a single governor, and he the creature of an insurrection, expiated his rebellion on the scaffold.

The election of governors recalls the election of Frankish kings, but really repeats that of the governors of commercial companies; how powerful such elected functionaries may become is shown by the chairman of an English railway company and the American boss. Leaders like Smith or Winthrop, Cargill of Otago, or Godley of Canterbury, who give to young colonies cohesion and the power to survive, or carry them through perils, are their rulers by indefeasible sovereignty; in form they may, as in Massachusetts, be only the presidents of the company out of which the colony has sprung. Reelected for twenty years, like Winthrop, or thirteen, like Endicott, they may confer on the office a duration equal to that of inheritance, and may show an independence greater than a hereditary or an appointed officer can safely assume. Creators of colonies, like Baltimore, Penn, and Oglethorpe, repeat a type that must be rare in history, if indeed they do not originate the noblest of all types of ruler, and are kings by a diviner right than that of any known sovereign.

The governor being the brain (or the active portion of the brain) of the body politic, the *administration* is his limbs, and expands from him with such improvements as new circumstances permit and such modifications as they require, in the same manner as it had done from the sovereign in the mother country. Not that each colony passes through all the stages through which the latter pass; that depends on the date at which the colony was given off. Massachusetts and Virginia alone of the North American colonies, New South Wales and Tasmania alone of the Australasian, described most of them; in the younger colonies the earlier ones were dropped. Thus (to mention a single point) the office of Colonial Secretary (who was originally the governor's secretary, as the Secretary for Ireland, till the other day, was only the Lord Lieutenant's secretary) differentiates into several ministries, as the department of Secretary of State had differentiated in England. An anomaly is worth noting. In the United States, where the whole people is the fountain of power, the ministers are the servants of the President, appointed and dismissed by him. In England, while they are still in theory her Majesty's ministers, and the Prime Minister is nominally selected by the sovereign, by a remarkable transformation they have become the servants of the legislature—that is, of the people. The two countries have exchanged institutions, as Hamlet and Laertes exchanged rapiers. The explanation is historical. The United States parted from the development of Britain at a time when the executive was, far more than now, independent of the legislature and dependent on the sovereign. The framers of the Constitution of the United States, looking at the British Constitution from without, and ignoring the subtle checks and balances that gave the lie to Montesquieu's too rigid trichotomy, petrified a still developing system, and dug a gulf between the executive and the legislature. But in England, with the growing weakness of the crown and the growing strength of the legislature, the ministers have gone over to the popular side. The younger British colonies were founded at a time when this development was already far advanced, and they have repeated the evolution. A curious consequence ensues. While in a monarchical country and its colonies a manifestation of public opinion can in a week bring the most powerful ministry to its knees, the President and ministers of a popularly governed country pursue their irresponsible course in apparent indifference to either pulpit or press.

A similar cleavage divides the *legislative* structure. The governor of crown colonies, like the sovereign, is at first the sole, and through his ministers to the last the chief, legislator; the legislature is created by concessions wrung from him, and its history is the record of successive limitations of his authority. In charter colonies the legislature is the creation of the people, and the laws are made by its deputies. A single tolerably perfect example of each type is chosen. The early history of New South Wales is one of the best preserved specimens in the museum of political paleontology. During its earliest years the governor was as absolute as the first Norman sovereigns. William Rufus might ask: "You Taillebois, what have you to propose in this arduous matter? . . . Potdevin, what is your opinion of the measure?" And Philip, hunter or king, might as unceremoniously solicit the advice of the chaplain or the commander of the forces, but they were under no obligation to take it; and the earliest laws, like the capitularies of Charlemagne, were public orders or proclamations. Under the sixth governor, when civilian officials had arrived, his authority received its first limitation: a small council was instituted, consisting of the chief justice, the attorney general, and the archdeacon of Sydney. A few years later the council was enlarged by the inclusion of new officials, and an equal number of unofficial citizens, who were, however, nominated by the crown. So far, we are still in the twelfth English century. In 1828 began fourteen years of agitation for an elective council, and with 1842 we arrive at the colonial Magna Charta. The concession had hardly been made when, with the influx of fresh settlers, another agitation for all the rights of self-government was begun. It was complicated with the convict question, as the politics of the United States was long complicated with the slavery question, but was not settled with, though it may have been accelerated by, the settlement of that in 1848. Eight years later full self-government was granted, largely through the agency of one man. As a Wentworth had aided in subverting the liberties of Englishmen, a second Wentworth redeemed the honor of his name by proving the Shaftesbury of a second revolution, and procuring freedom for their Australian descendants. Subsequent developments repeat the English reforms of 1832, 1867, and 1881. Thus the colony described in less than a century the evolution which it had taken the mother country fourteen hundred years to accomplish. Younger colonies, omitting the earlier stages, ran the same distance in far shorter periods.

They are not only repeating, they are anticipating, the history of the parent state. Female suffrage has been conceded in two Australasian colonies, and it is inevitable in the rest. The domination of a socialist democracy is far advanced in the two former. The referendum, or direct appeal to the people on specific issues, is on the eve of general enactment. Ministries elected by the legislature are possibly in the near future. Thus legislative bodies which sprang from the crown are more democratic than those that sprang from the people. Withal, the former retain an anomalous vestige of their origin. While the business of legislation in Congress is necessarily conducted by members who have no official connection with the executive, as it was originally in the English Parliament, the British and colonial ministries claim an ever-increasing monopoly of legislation on all questions of any magnitude. It has long been recognized as impossible for a private member to carry through the House of Commons a measure of any consequence, and a colonial ministry arrests the progress of a successful bill by intimating that the subject of it can only be legislated upon by the Government.

The free involution of a legislature from below is naturally more rapid than its reluctant devolution from above. The swift development of the Massachusetts Company into the Massachusetts Legislature has been ably traced by Professor Fiske, who is a sociologist as well as a historian. The attempt to transact public business at a primary meeting of all the freemen in the colony, assembling four times a year, repeats the old Witenagemot, and failed for the same reason as that died out—because, from the expansion of the population, the assemblage was impracticable. It needed only four years for the freemen to acquire the right of sending deputies to the General Court, and only fifteen to bring about a permanent division into two Houses. Other early colonies passed through the same stages; colonies of later foundation took up the development at the bicameral stage. It is the history of a land and colonization company of those days, or of a railway company in ours. The directors become a Senate and the body of shareholders the popular House; the statutes of the company are its constitution and the by-laws its legislation. The origin of charter legislatures in a company explains a parallel anomaly to that in crown legislatures. While the representative Houses in British colonial legislatures have followed the House of Commons in gathering all power into their own hands, in states descended from the charter companies the House of Representatives has been losing, while the Senate has gained authority. In both cases the apparent anomaly is the outcrop of a deeper law. The ministry in the one case and the senate in the other are each the embodiment of that continuous social germ-plasm to which the popular will of the hour stands in the same relation as the individual life does to the physiological germ-plasm; and, as the latter is the true substance of the body, the social germ-plasm is the substance of society, incarnating its permanent interests, and therefore justly overriding the cries, the whims, the passions of the hour.

The same dichotomy is visible in the colonial *judicature.* The *paterfamilias*, the village elder, the tribal chief, the king, possess and personally exercise an undelegated jurisdiction. Fully twenty years ago a sociological worker surprised a historian of some pretensions, who was conversant with the mere events of his special period, by informing him that the practice of English kings to preside in their own courts of justice came as far down as that very period—the reign of James I. This prerogative was transmitted with the other attributes of royalty to the governors of crown colonies, who "generally acted as judges, sitting in the highest court." A New Jersey Cincinnatus revived primitive simplicities by hearing causes seated on a tree stump in his fields. The successive delegations of this power repeat the necessary concessions that created the English judiciary. Side by side with the royal prerogative grew up a popular jurisdiction which developed into the jury; and it would be worth while to compare the acquisition of this constitutional right (for example, in Connecticut and New South Wales) with its history in England. Out of this element, and also as a corollary from the election of a governor who was chief judge, came the practice of electing judges in the North American colonies. It was by no means confined to the charter colonies. Nowhere was the determination toward an elective judiciary more noticeable than in Pennsylvania, whose proprietary was its feudal sovereign. It may be historically explained from the corrupt and servile judicature of the age when these colonies were founded. The attachment to the old system in contemporary British colonies may also be explained from the very different point in the history of the mother country when they were given off, when the talent, the purity, and independence of the bench had become the pride of Englishmen, and the judges were Baconian in everything but the taking of bribes. The English and (naturally in a far less degree) the colonial courts still show traces of their royal origin in the antiquated wig and gown, the arrogance of the judges, their haughty point of honor—"contempt of court," and their aristocratic bias. These are counterbalanced by the increasing strength of the popular element. A hopeful bill was a few years ago introduced into a colonial legislature restraining judges from commenting on evidence. A mere act of Parliament would have as much effect on lawyers' loquacity as Mrs. Partington's mop had on the Atlantic. It is, nevertheless, in the direction of restricting the powers of the judges that the more radical colonies are moving. In one southern community certain causes may be tried by a judge with a jury of four, who will probably rise into assessors, and in another that important step is possibly on the point of being taken. The courageous Premier of South Australia, who lately defied the entire English medical profession, has now taken in hand his own not less formidable guild. He proposes that "in proceedings under certain acts the bench is to consist of a judge of the Supreme Court with two lay assessors, one appointed by each party to the suit"; and counselors are peremptorily excluded from such proceedings. In certain other cases litigants may submit statements of their differences to judges who will adjudicate without the intervention of counsel. Thus the same middle point may be reached from opposite termini. A series of levelings down may bring judicatures of royal origin to the same stage as popular jurisdictions have reached by a gradual leveling up. The courts will then unite the majesty of the law, whose "voice is the harmony of the world," with an impartiality and inexpensiveness that will insure to every citizen the enjoyment of the most elementary of all rights—the right to justice.

Side by side with the process of differentiation within colonies rose up an integration of colonies with one another, which also repeats the history of the mother country. The same principles of authority and consent, again in unequal proportions, are blended here. It was by conquest that the seven old English kingdoms were welded into a united England, Strathclyde incorporated, Ireland annexed. By force disguised as bribery, aided by the patriotic or interested efforts of a few nobles and placemen and in opposition to the will of the inhabitants, Scotland and Ireland were joined to England. Some four or five groups of British colonies have reduplicated, or are now reduplicating, a parallel development. In North America it was preceded and accompanied by altercations among the different colonies. Boundary disputes repeat old English intertribal struggles. Tariff wars are now waged, and commercial reciprocity treaties contracted, between contemporary colonies. New Haven and Connecticut, which consisted of towns federated by consent, were united by force. Voluntary alliances against the Indians or to conquer Canada, or involuntary unions under despotic rulers, associated larger or smaller North American groups from Maine to Maryland. The loose confederation of 1781 was too voluntary to last. The final federation that superseded it had a large element of latent force mixed with consent. It was hardly less a conquest of the North by the South than that of the Heptarchy by Wessex. The Constitution is a monument of Southern ascendency. So it was that, for seventy years off and on, the United States was governed by a Southern oligarchy, whether under the hegemony of Virginia or of South Carolina. The dominion of Canada means (even under a French premier) the dominion of Ontario, with Quebec bribed, and Newfoundland not bribed enough, to enter. In 1876 the ten New Zealand provinces were amalgamated under a central Government which for many years remained that of the earlier-settled North Island. A federation of the Australian colonies planned seven years ago under the auspices of protectionist Victoria, is likely to succeed under the leadership of free-trading New South Wales. Mr. Rhodes is advising the federation of the British colonies of South Africa; forty years ago a federation of all the South African states was designed by Sir George Grey, then high commissioner, but with little patriotism and still less wisdom, for at that time it necessarily implied the dominance of the Dutch element. In 1846 that far-seeing statesman had projected a union of the South Sea Islands with New Zealand. Only four years ago the same aged prophet of federation, with an eloquence inspired by the theme, outlined to a Liberal audience a scheme for federating the English-speaking peoples. These are dreams; but the dreams of to-day are the realities of to-morrow, and every step taken toward the realization of them is itself a gain.

ARCHITECTURAL FORMS IN NATURE.

By F. S. DELLENBAUGH.

"Semblance of castle and arch and shrine
Towered aloft in the clear sunshine."

THE world is old, yet the world is new. It is old in our sight because it has endured for a time that from our puny standpoint seems long, but which, gauged by the standard of eternity, would barely be represented by a single tick on the dial that knows no beginning and no end. It is a work still in process; when it is done the human element will not be here to admire or condemn it. When in the long ages of its development parts of the solid crust have been pushed above the waters, the elements have combined to pull them down and sink them again under the seas. It is a battle between the waters and the dry land, and when during the refreshing shower we see the rivulet at our feet brown with mud, we see the victory of the rain; we see the price the earth is paying to this subtle foe. This warfare goes on day by day, year by year, age by age, and will go on as long as a dry rock rears its head above the deep. The rains and frosts and winds, acting on the exposed surface with unceasing energy, have in many localities produced strange contours and striking resemblances to objects familiar in our daily life, especially to buildings and other structures due to the hand of man. These are often on a giant scale. But, in addition to the quality of size, these natural forms possess

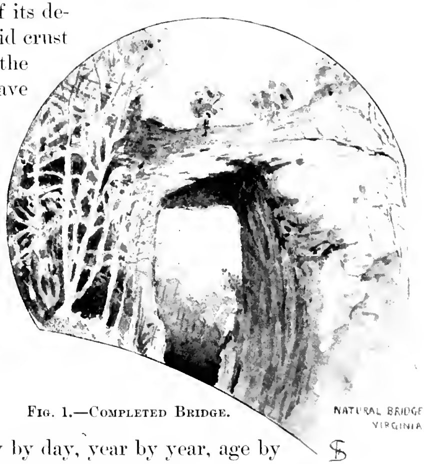


Fig. 1.—Completed Bridge.

as well the ever-important element of beauty, without which bigness is vulgarity. Nature is never vulgar. Whether we look upon the roadside violet that wilts under the touch, or whether we stand wondering at Niagara, or strain to see the tiptop rock of the Grand Cañon, we may always discern a radiant beauty, which pervades the

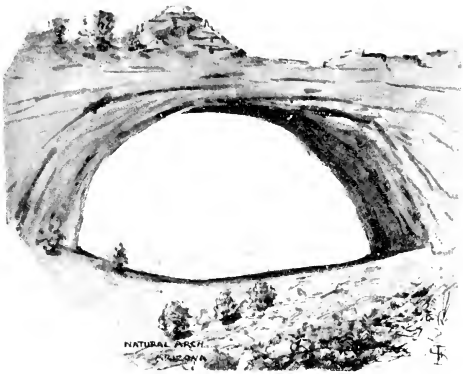


Fig. 2.—Completed Arch.

world to its foundations, and is poured out upon us unmeasured and unpriced.

So these architectural forms that result from the perennial battle between the dry land and the sea, no matter what their size, are charming in majesty, in proportion, in harmony of color, and in variety and grace of outline. Our imaginations are constantly in search of resemblances, and it is not strange, therefore, that every land presents to human curiosity numerous specimens, though it must be admitted that the mind is sometimes taxed to discover the likeness. On the other hand, some are so evident as to have acquired a world-wide celebrity. The Natural Bridge of Virginia (Fig. 1) is not only a resemblance, it is a reality. In the Rocky Mountain region are numerous other bridges formed thus naturally. In the Cañon of Desolation, Green River, Utah, far above the water are many natural arches in the thinner salients of the monster cliffs. These perforations are often two thousand feet above the river, looking like enormous windows opening on some other world. In one a pine tree that must have been at least a hundred feet high was growing, and its top was many feet below the crown of the arch. Wherever this particular formation is exposed, these arches or bridges occur in all stages of development. The sandstone of this formation has the peculiarity of fracturing conchoidally, and when the face of a cliff contains one of these fractures (due to weathering) and is not thick, some crevice is sure to open a path to the enemy, which is soon widened to a highway for the frost and rain, and a cascade in shower-time pours down, picking up sand as it goes to help in the attack. The weathering becomes more rapid, the arch opens up, and in time a natural bridge (Fig. 2) spans the air where once there was but solid stone. The process continuing, the bridge will disappear, a vacancy will take its place, and far off in the river bottom, or still farther in the sea, will rest the disintegrated material that once made part of the continuous cliff. Where the cliff is too thick to be perforated (Fig. 3), the arch breaks back into a deep cavern whose roof falls and falls till the blue sky takes its place. Thus has a natural bridge, like a flower, its birth, its growth, perfection, and decay. Wind erosion also plays a part, but the chief work is due to water.

Besides bridges there are numberless other forms. Who has not seen Castle or Pulpit Rocks, or Devil's Slides, or Palisades, etc.?

Fig. 3.—Middle Stage of a Bridge or Arch.

But it is in the West, perhaps, that the most remarkable rain carvings and wind carvings occur, and especially in that part called the Southwest, that "land as old as time is old," that strange, weird land of red rocks, of tall, long cliff lines like mountain ranges split asunder to span the desert in their nakedness; that land of labyrinthine cañons, where the bloom of morning lingers to kiss the gloom of night; land of isolated buttes that frown in lofty silence on the lower world like monuments belonging to some cemetery of giants; land of *mesas*, plateaus, pinnacles, and peaks.

The massive red-and-yellow buttes at Green River, Wyoming, are familiar to passengers on the Union Pacific Railway, and have

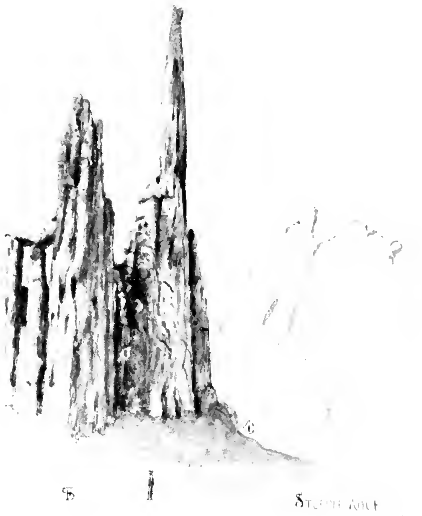


FIG. 4.—"GARDEN OF THE GODS."

been beautifully rendered on canvas by Thomas Moran. Visitors to Colorado Springs will not forget the superb "Steeple" and "Cathedral" rocks in the Garden of the Gods (Fig. 4), whose gorgeous vermilion is thrust vertically into the Colorado blue; and many there are who have seen the wonders of the Yellowstone and the Yosemite. In all these places there are architectural forms that have justly received the admiring tribute of thousands, yet in more remote regions are forms quite as remarkable that have seldom been seen by the eyes of white men.

While riding northward across the Navajo Indian Reservation from Fort Defiance, I well remember seeing, at a distance of a mile or so, which may have "lent enchantment to the view," an immense arch in red sandstone, and, more interesting still, one of the most perfect suggestions of a building I have ever seen. To go closer at the time was not practicable, nor even to stop for a more deliberate study, but they were in sight from the slow-moving cavalcade for a considerable time, and I have always remembered them as about the most perfect architectural forms I have seen in all the West.

Pinnacles and multitudinous other forms were also there, and a close inspection would doubtless have discovered many quite as near perfection as those which attracted us from afar.

In other places in this same locality huge volcanic masses had been pushed mysteriously, in remote geological time, here and there through the strata of sandstones, and the layers of water-made rocks having been subsequently cut away by the rains, the harder fire-made rocks offering more resistance were left behind in tall spires, towers, and various fantastic shapes. To one of them, revealing from the mountains above it a central mass with winglike dikes spreading out on each side, the Navajos have applied the name of *Tsebetai*, "The Stone Bird," and by this name it is now known to all who enter the barren and peculiar country. Gazing down upon it one day from the crest of the Tunicha Plateau, I was instantly impressed by the felicity of the Indian title, for there it lay upon the plain exactly like a great buzzard petrified with wings outstretched for flight.

As a rule, it is not the volcanic rocks that furnish the close images of bird, beast, or building. The sedimentary or water-made rocks yield the greatest number and the closest resemblances. Even in towers and pinnacles the water-made rocks, though softer, come out ahead, frequently sending up their splendid shafts to hundreds of feet, or to a full thousand, like the "Captains" in De Chelly Cañon, Arizona (Fig. 5). Minarets and spires from one hundred to three or four hundred feet high might be counted by thousands in the cliff and cañon country.

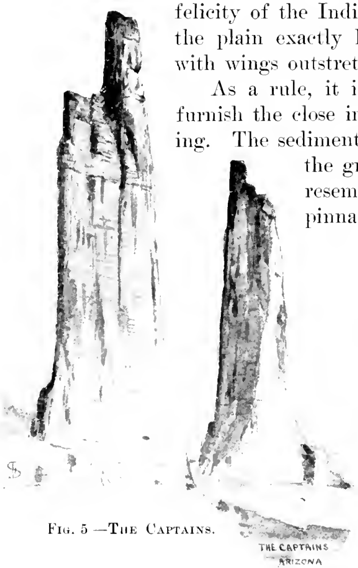


Fig. 5—The Captains.

In far-away Greenland Dr. Kane came upon the red sandstone, "dreamy semblance of a castle flanked with triple towers, completely isolated and defined," which he named the "Three Brothers Turrets" (Fig. 6). Not far from this he found a still more singular and impressive shaft, whose poetical symmetry caused him to name it "Tennyson's Monument" (Fig. 7). This he describes thus: "A single cliff of greenstone, marked by the slaty limestone that once incased it, rears itself from a crumbled base of sandstones, like the boldly chiseled rampart of an ancient city. At its northern extremity, on the brink of a deep ravine which has worn its way among the ruins, there stands a solitary column or minaret tower, as sharply finished as if it had been cast for the Place Vendôme. Yet the length of the shaft alone is four hundred and eighty feet, and it rises on a plinth or pedestal itself two hundred and eighty."

In some of the cañons of the Great Walled River, the Colorado of the West, turrets, pinnacles, and even natural arches stud the

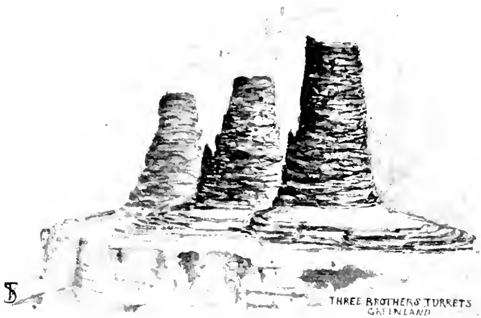


Fig. 6.—Three Brothers Turrets.

walls with countless imitations of architectural forms, every bend of the stream offering some fresh novelty. In parts of Marble Cañon the high walls are eroded into endless alcoves, caves, towers, weather-beaten castles, and a thousand and one weird or fantastic forms. One night, just below our camp, was a perfect semblance of a ruined castle. Around the indentations which answered for crumbling windows clung carelessly bunches of mosses and ferns, while at one side from a mass of emerald verdure, rendered greener and sweeter by contrast with the miles on miles of barren red cliff up and down, gushed forth a clear spring whose waters, churned to silver, dashed through the vines into the deep river a hundred feet below.

In the Cañon of Desolation, twenty-four hundred feet above the surface of the river, surrounded by pine trees, is a formation that seemed from below so exact a counterpart of a pioneer log cabin that it was difficult to believe it was only a deception. The beetling wall which it surmounted was named "Log Cabin Cliff."

Another class of resemblances are those called "domes." The Domes of the Yosemite are a well-known example, but the Five Domes of the Virgin River in southern Utah are perhaps quite as wonderful, while having the advantage of more inviting color. The region surrounding them is one of the most remarkable scenic spots on the continent, and in time will become as celebrated as the Yosemite or the Yellowstone. It has fewer freaks and curiosities, perhaps, but probably more real beauty. Not far from the Five Domes are the Temples of the Virgin (Fig. 8), similar to the domes, but more rugged at the top. These are veritable temples of the gods, solid as the rock-ribbed earth itself.

There are also in some places domes hollowed out. In Glen Cañon of the Colorado, a little below the mouth of the San Juan, is a dome of this character carved out of the homogeneous sandstone by the action of a pretty brook, which in fair weather is a mere rivulet, but in rain time is an angry flood, sweeping down on its tide immense quantities of sand. This little stream enters at the back of the cavern through a very deep, narrow cleft, not more than a foot or two wide, and after a plunge of some thirty feet or more into a clear pool trickles on out to the river, which flows past the entrance. The chamber is about two hundred feet high, with a narrow crevice twisting on up to the top of the cliffs, about a thousand feet, while the area of the sandy floor is about two hundred by five hundred. Its mouth is barred by a little grove of box-elder trees. When the storm is abroad the innocent brook grows to a giant in an hour, because of the rain accumulating on the barren, rock-surfaced country as on the roof of a house, and, gathering the load of sand in its impetuous clutch, it hurls it against the bounding walls, thus doing its part in the war of the waters against the land. I have counted dozens of these cascades leaping over the cañon walls during heavy rainstorms. An exploring party once camped within the dome mentioned, and, thinking it rendered well their songs, they named it "Music Temple." Some carved their names on the soft sandstone wall, and three of these a short time after were sent by the Indians to the Great Dome of all.

FIG. 7.—TENNYSON'S MONUMENT.

The extensive Pink Cliffs, forming the escarpment of the southern edge of the Great Basin, are of the colonnade type, and for many miles their exquisite color and massive columnar façades crown the high country ten thousand feet or more above the sea, visible far to southward, and with the underlying Gray Cliffs and the still lower down Vermilion Cliffs (which find their beginning in Glen Cañon of the Colorado, and trace their serpentine line leagues to the west to meet the Temples of the Virgin) form one of the most magnificent panoramas to be found anywhere in the world. Detached and isolated portions of these Pink Cliffs, surrounded by the upper members of the Gray, produce sometimes novel effects. I recall one sunny morning when I found myself suddenly in a silent grassy glade, green and gray all round, with before me what can be likened only to an immense pipe organ, its delicate pink columnar pipes standing full two hundred feet high against a somber background of pines where Æolus could be heard sighing for the lost chord.

Fig. 8.—Temples of the Virgin.

Major Dutton, in his Geology of the High Plateaus of Utah, says of these Pink Cliffs: "The resemblances to strict architectural forms are often startling. The upper tier of the vast amphitheater is one mighty ruined colonnade. Standing obelisks, prostrate columns, shattered capitals, panels, niches, buttresses, repetitions of symmetrical forms, all bring vividly before the mind suggestions of the work of giant hands, a race of genii once rearing temples of rock, but now chained up in a spell of enchantment, while their structures are falling in ruins through centuries of decay. Along the southern and southeastern flank of the Paunsagant (plateau) these ruins stretch mile after mile. But the crowning work is Table Cliff in the background. Standing eleven thousand feet above sea level and projected against the deep blue of the western sky, it presents the aspect of a vast Acropolis crowned with a Parthenon. It is hard to dispel the fancy that this is a work of some intelligence and design akin to that of humanity, but far grander. Such glorious tints, such keen contrasts of light and shade, such profusion of sculptured forms, can never be forgotten by him who has once beheld it."

Thus everywhere the imagination is roused to the comparison of the natural and the artificial; with little effort it discovers classic outlines in these rain-carved forms. And occasionally there is something uncanny about them. In eastern Utah, some miles from the point where White River joins the Green, and close by the former stream, lies a whole group of natural edifices, to which General Hughes applied the name of Goblin City. Remote and lonely at the time of our visit, in the midst of a hostile country, the numerous small houselike buttes, resting like a real town in the bottom of the rugged, desolate gorge, seemed about to pour out an angry host, to stop our further entrance into their weird and forbidding land. The broken cliffs through which we had descended to the "City" presented detached rocks here and there looking like petrified guardsmen who might only be revived by the Prince's kissing the Sleeping Beauty, somewhere perhaps to be found in this goblin realm.

Gunnison's Butte, on Green River, not far from the point where the brave captain crossed the stream in 1853, is a fine example of what may be called the cathedral type (Fig. 9). Rising supreme in colossal dignity twenty-seven hundred feet above the river bank, in its tender color, in its splendid lines, it is without a rival. On its southwestern part, toward the base, the numerous abutments and little slopes crowning them are of a pure delicate blue, rivaling the tint of a summer sky. Extending far to westward, these Azure Cliffs, which begin with Gunnison's Butte, present one of the most remarkable and beautiful touches of color the rocks have ever unfolded. Near the mouth of the San Rafael, Dellenbaugh's Butte (Fig. 10) exhibits a different type, likened by the explorers of the region to an art gallery, because of its broad roof and simplicity of outline. Four hundred feet high, its chocolate-brown mass rests beside Green River, silent, serene, as if waiting for the jury to finish arranging the exhibit and open the doors to the public.

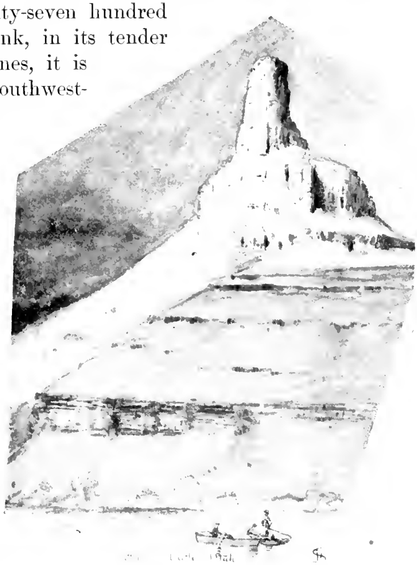


FIG. 9.—GUNNISON'S BUTTE; 2,700 feet above river.

Monument Rocks near Colorado Springs are well known for their fantastic shapes, but another set of similar monuments in southern Colorado are not so familiar, and have been formed in a different way. Those near Colorado Springs are due to a hard spot in the rocks acting as a kind of roof for the portions below, but in the other case the resistance has been offered by fragments of basalt rolling down to a plain from a neighboring hilltop, and assuming protection over the area upon which they happened to rest. Thus they soon found themselves topping numerous adopted monuments twenty or thirty feet high (Fig. 11).

Fig. 10.—The Art Gallery.

One of the most out-of-the-way regions left within our boundaries is that lying around the junction of the Grand and Green Rivers in eastern Utah. These two rivers, flowing at this point in cañons about twelve hundred feet deep, come together in a cañon thirteen hundred feet deep to form the Colorado. You climb out from the junction by a narrow crevice, and on top find yourself on a barren, much-cut-up plateau. The surface is verdureless, consisting for the most part of bare rock split by numerous crevices. You are in the midst of "The Land of Standing Rock," as the Indians call it. Powell, in referring to this locality, says: "We must not conceive of piles of bowlders or heaps of fragments, but a whole land of naked rock, with giant forms carved on it; cathedral-shaped buttes towering hundreds or thousands of feet; cliffs that can not be scaled, and cañon walls that shrink the river into insignificance; with vast hollow domes, and tall pinnacles and shafts set on the verge overhead." Near and far in all directions the eye encounters pinnacle after pinnacle, butte after butte, cliff after cliff, like a stone forest, impassable, impenetrable, except to the trained

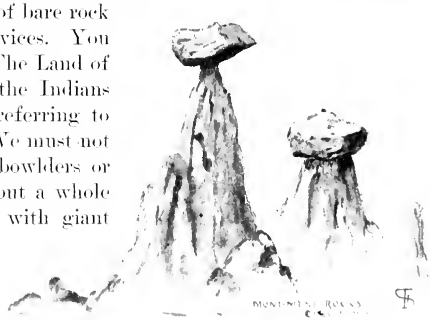


Fig. 11.—Basalt Topping Earth.

mountaineer. Some of the shapes here are most peculiar. One which I call the Synagogue (Fig. 12), as no other name, so far as I know, has ever been applied, is representative. Its lines are strikingly like those of the temple of Khandaria in Khwahrao, Central India. It has a round main structure, showing several deep lines of horizontal molding, and is of a deep reddish-brown color. The "roof" is a light pinkish red, as I remember it, and rounds up to a central cupola of the lower color. Springing from the front is a beautiful minaret, carrying the darker color to the apex.

Though strange rock structures abound in all this region, it is in the specially arid portions that they are most common. The strata

Fig. 12.—The Synagogue.

being unprotected by vegetation, the wearing away is more rapid, and follows more eccentric lines. The higher and drier a locality, there—provided there is some rainfall—will be found the most extraordinary rain carvings. The lack of abundant rain prevents the growth of vegetation and the altitude permits the rain torrents to carry loads of sand, and the more sand and velocity the greater the scouring. In some of these intermittent stream courses the sand and bowlders scoop out deep holes like huge pots—a variety, in fact, of the hole known in geology as "pothole" (Fig. 13). These are very deep and sometimes provide a thirsty traveler with a draught of clear water that has lingered from the last shower. In some places these "pockets" or "tanks" supply the only water to be had, and it is a glad sight when one sees a pocket before him. Each formation has its own peculiarities of erosion, or as Dutton aptly puts it, "its own school of natural architecture." Given, then, a particular formation exposed to the atmosphere, it can be foretold just what its natural architectural forms will be, whether domes, minarets, pinnacles, arches, towers, or what.

Architectural forms are not confined to the United States, nor to the American continent. The Giant's Causeway in Ireland is a familiar example of what they have in those parts, while under the Arabian sky the conditions resemble those in our arid Southwest,

Fig. 13.—Potholes in Intermittent Stream Course.

and there we find many fantastic rain carvings. Among these is the Sphinx of El Guerrah, carved by the rain-sculptor doubtless expressly to furnish answers to our "whys and wherefores" concerning this "wondrous architecture of the world."

Among the applications proposed for the newly liquefied gases is their use as aids in balloon navigation. An aëronaut having a few bottles of liquefied hydrogen or illuminating gas has the means of increasing the inflation of his balloon when necessary, and need not fear to waste a little gas when he wishes to diminish its levity. Prof. L. Errera, of Brussels, has suggested an apparatus which he calls the *ceinture de natation*, or natation belt, by which these objects can be conveniently accomplished.

THE HERDS OF THE YELLOW ANT.

By JAMES WEIR, Jr., M. D.

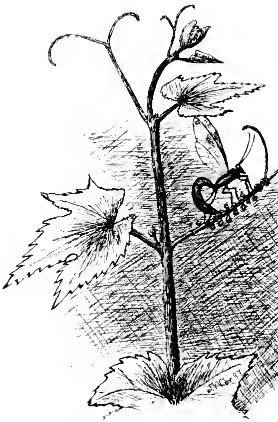
As far as my observations go, and they extend through a period of twenty years, the aphides which live on grapevines, and which are the peculiar cows of the common yellow ant (*Lasius flavus*) of our gardens, show many curious phases in their life history. Especially is this true of the manner in which they perpetuate their species.

If a colony of aphides be kept under observation during the summer, it will be noticed that several kinds of individuals arise within it. By far the largest number of the herd will be made up of the wingless agamic form—that is, of females which reproduce without mating. In the species under consideration the young (*during the summer*) are born alive, and do not come from eggs.

So rapid is the increase of these insects that overproduction would soon kill off the colony by starvation were it not held in check by the peculiar anatomical and physiological metamorphoses which make their appearance in the offspring from time to time. Every now and then young ones are born which, in the course of time, evolve two pairs of wings; these winged individuals (which are also females and agamic) abandon the colony and produce elsewhere, in turn, wingless and *single-winged* individuals. In autumn both males and females are born; these mate and the females lay eggs.

These creatures secrete a honeylike fluid which exudes from two tubelike teats on the back of the sixth abdominal segment. Ants are passionately fond of this honey-milk and jealously guard and protect the herds of aphidian cows which produce it. They can be seen at all hours of the day, busily engaged in milking their queer kine. They will gently stroke the aphides with their antennæ, thus inducing a free flow of the nectar from the abdominal tubules. Calves effect a like result by nudging their mothers with their heads; the cows " give down " their milk when thus assaulted by the calves.

In autumn, as soon as ovipositing has begun, the ants gather the aphis eggs as fast as they are laid and carry them into their nests. Here they remain, carefully guarded and protected by the ants, until they hatch out in the spring, when the young agamic females are carried out by their foster mothers and placed upon the tender grape shoots or buds. This year the ants brought out the young aphides, which formed the herds kept under observation this summer, on the 18th of March. On the 19th they carried them back into the nest; this occurred in the forenoon, when the sun was shining and the air was warm and balmy. About 12 M. it began to storm, and became quite cold; that night there was a hard frost. The ants evidently knew that this change in the weather was about to occur; therefore they removed their property to a warm and sheltered place. I have often watched the ants in autumn when the aphides were ovipositing; the former would caress the latter, and seemingly would endeavor to stimulate and cheer them during the operation. As soon, however, as the eggs were deposited, the ants would seize and carry them into the nest; the aphis mother was left, without any compunctions whatever, to die during the first frost! Her life work had ended, and the economy of Nature needed her no longer.



Ichneumon Fly laying Eggs on Aphides.

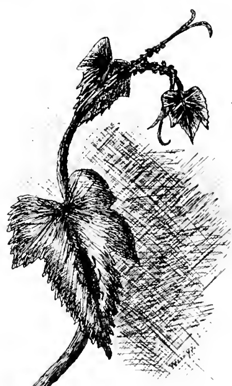
Ants are always on the lookout for the new colonies which are continually being started by the winged females. As soon as one of these new herds is found by an ant, she returns to the nest and notifies her companions. One or two ants then accompany her to her newly found treasure, which in future is always, night and day, under their watchful care. As the herd increases in numbers, additional herdsmen, or rather dairymaids, are called into service.

Associated with this species are commonly to be found other species of aphides, notably the one which secretes, or rather excretes, a white powdery substance which is to be seen on their backs in soft, plumose masses. On microscopic examination this substance is found to be fairly teeming with microbia. These microbes, at the first glance, seem to be of different species; maturer judgment, however, declares them to be but metamorphic forms of the same individual.

A "white" aphis can be seen in the photograph at the base of the upper leaf stem. With a small pocket lens the details of this creature's structure can be easily made out. There are several of these aphides on the vine, but the one mentioned is the largest and the most conspicuous. They are much larger than the nectar-producers, are oval in shape, and distinctly flattened. In fact, in general outline they are strikingly like that *bête noire* of all good housekeepers—the *Cimex lectularius*. The ants frequently congregate about these little creatures and appear to be paying them some kind of court. When I cut the vine for photographic purposes, six or eight ants were standing about the large individual mentioned above; they soon became aware that some dire calamity had happened, or was about to happen, either to their beloved herd or to themselves, and, becoming frightened, soon abandoned cattle and pasture and fled away in panic terror. I had hoped to photograph them *in situ*, but found this to be impossible with the instruments at my disposal.

The ants do not "milk" these white aphides, neither do they eat the excrementitious substance on their backs. The white individuals, however, seem to be factors in the social economy of the herd, for the ants move them, on occasions, along with the herd to other pastures. Once I saw an ant pick up a white aphis and carry it to a leaf some little distance away from the colony; she then returned, picked up a gravid nectar-producing aphis, and carried her to the spot where she had left the white individual. In a few days a fine herd of "milkers" was to be seen grazing in the new field. I judge from this that these white aphides are in some way useful to, if not absolutely necessary for, the welfare of the herd.

The winged females have both compound eyes and *ocelli*, or primitive eyes, yet they seek the under surface of the leaf, thus seeming to prefer the more subdued light to be found there. The young are always deposited on the under surface of the leaves; in a few days, however, they either migrate of their own accord to the more succulent stems or are carried thither by the ants, which never cease to watch over and care for them.



An Aphis-Lion.

In order to test this guardianship, I have frequently wounded the vine below a colony of aphides, thus cutting off, to a certain extent, the flow of sap. The ants would soon discover this and would at once begin to move the herd to another vine. The aphis is provided with boring and suction organs somewhat similar to those of the mosquito. In point of fact, it is interesting to note that the ancestors of the mosquito, in all probability, lived wholly on the juices of plants; hence, in this respect, the resemblance is more real than apparent. Aphides, also, like mosquitoes, have the curious habit of elevating their bodies, "standing on their heads," after they have become gorged with food; this can be observed in the drawings.

The cow of the yellow ant should not be confounded with her harmful cousin, *Phylloxera vastatrix*, the deadliest enemy of the grape. Fortunately for us, this last-mentioned aphis does not abound in the United States; in France and other European countries, however, phylloxera has occasioned the loss of millions of dollars.

Cocoon, Larva, Eggs, and Adult of Aphis-Lion (*Chrysopha*). Slightly modified from Comstock.

Notwithstanding the fact that the ants are exceedingly zealous in guarding their property, many of the aphides fall victims to the assaults of their enemies. The most cunning, insidious, and crafty of their foes are the ichneumon flies, three varieties of which are continually, during the summer months and in autumn, endeavoring to cradle their young in the bodies of the aphides.

One of these flies, which can be seen in the drawing, is quite large; I am inclined to believe, therefore, that their larvæ do not pupate in the bodies of their hosts, but undergo further metamorphoses elsewhere. Another of these flies is very small, hardly larger, in fact, than the insect which it selects as a living cradle for its young. The ichneumon shows rare intelligence, inasmuch as she invariably deposits her eggs on the young members—the calves, as it were—of the herd; she seems to know that the older aphides would die before the ichneumon grubs arrived at a suitable age for pupation; hence she selects the young ones. She runs here and there about the colony until she finds a young aphis; then, curving her abdomen between her legs, she will quickly lay an egg on the body of the unconscious insect. When the egg hatches the larva feeds on the body of its host (carefully avoiding the vital organs, however) until the time arrives for it to undergo further metamorphoses. The animated cradle and cupboard eventually dies, but not until its queer baby has arrived at an age at which it has no further use for it.

The ants are fully aware of the fact that the ichneumon is a deadly enemy of their cows; hence, when one of these flies is seen hovering over the herd, they at once become alert and endeavor to chase her away whenever she alights. She manages, however, to elude them every now and then, and to lodge her fatal eggs on some of the tender young aphides.

Another implacable foe of these creatures is the larva of a neuropterous insect which in its perfect or mature form resembles the dragon fly. It is technically known as an aphis-lion, and differs very widely in habits from the common and well-known ant-lions. The last-mentioned grubs dig pits, at the bottoms of which they lie in wait for and seize their prey whenever it falls therein; the aphidian lion is, on the contrary, a bold and skillful hunter, and takes its prey wherever it may find it. It is an ugly, heavy, slothful-looking grub, yet it is remarkably agile. When darting upon its quarry (and it hunts the winged aphides only), its thick, clumsy-looking legs move with such rapidity that they can scarcely be seen. Its movements as well as its shape are decidedly lacertilian; in fact, when it is seen coursing over the grape leaves in pursuit of its prey, it reminds one irresistibly of the brilliant little lizards which are to be observed running here and there over stone walls, fences, and sunny woodland paths. This creature stalks its prey like the lycosids or hunting spiders, and fairly bounds upon it when it arrives within grasping distance. Its catlike movements when creeping up on its quarry are wonderful to behold, and indicate a very high degree of intelligence.

A Colony of Aphides.

In color it is jet black; in fact, in certain lights it glistens like a jet jewel. It is about half an inch long and one sixteenth of an inch broad. On the margins of its body, from its head to its tail, are rows of thornlike spines. Its masticatory organs, as well as its viscera, are much more highly developed than are those of ant-lions. It is a brave little creature, and only succumbs to the ants (which make war on it wherever they find it, thus showing that they are fully aware of the fact that it is inimical to their herds) when life ceases. During the last twenty years I have frequently observed this larva, and have endeavored to follow it in its metamorphoses. I have succeeded only once, however, in carrying it through to its *imago* or perfect form. It is not described in any of my lists, and may be, therefore, a new species. There is another aphis-lion which in very many respects closely resembles the one just described. It is pictured by Professor Comstock, a modification of whose drawing is here produced. He writes of this creature as follows:

"' When the aphis-lion is full grown, it rolls itself up into a tiny ball and weaves around itself a glistening, white cocoon, which looks like a seed pearl." (This can be seen in the sketch near the base of the upper leaf.) " It may be supposed that while the aphis-lion is secluded in this pearly cell it repents its greedy, murderous ways, and changes in spirit; at least the body changes greatly, for, after a time, a circular lid is made in the cocoon, and out of it there emerges a beautiful, dainty creature, with delicate-veined, green wings, a pale-green body, slender brown antennæ, and a pair of large eyes that shine like melted gold. It is sometimes called golden-eyes, and sometimes a laced-wing fly, from its appearance."

This beautiful little insect evinces marvelous forethought in the matter of perpetuating her kind. She knows that her young are predaceous, devouring anything in the shape of an insect or an egg that they can secure; she is aware of the fact that, if she were to deposit her eggs, side by side, on a leaf, the first young aphis-lion hatched out would devour all of the remaining eggs. In order to guard against this, she spins a delicate but stiff stalk of hard silk, upon the tip of which she deposits an egg. By the side of this stalk she rears another, and another, and another, tipping each with an egg, until finally, when she has finished ovipositing, there appears a miniature grove of delicate silken stems, each one of which bears aloft on its summit a round and shining egg. When the first-born of this brood makes its appearance, it crawls down the stem to the surface of the leaf, and goes in search of food, utterly unconscious of the rich and toothsome feast just above its head on the tips of the other stalks!

Lubbock concludes, from certain experiments, that the yellow ant will not voluntarily drop from an elevation. Now, observations and experiments made by myself teach me that these ants (*Lasius flavus*) *will* drop from elevations when they wish to attain a certain object.

On one occasion one of the herds of aphides under observation was discovered by a wandering black ant (*Lasius niger*), which reported her discovery to her comrades. At once a marauding expedition was inaugurated by these cattle thieves, which fiercely attacked the yellow guardians of the herd. The black rievers swarmed up the grapevine, but were met by the brave yellow warriors, which valiantly withstood their attack. Finally, the yellow ants were in danger of being overwhelmed by numbers, when I suddenly perceived that they were being re-enforced. Closer examination revealed the fact that they were crawling up a neighboring vine and then dropping from an overhanging leaf on to the leaf on the stem of which the aphides were feeding. They could not reach the herd by way of the original path on account of the intervening army of black ants, hence their shrewd and most intelligent use of the neighboring vine and overhanging leaf. I am glad to report that the yellow ants were victorious, and that they completely routed the would-be robbers.

When alarmed, the yellow ant will draw in its legs and drop to the ground; moreover, this is characteristic of all vine- and tree-climbing ants, Lubbock to the contrary notwithstanding. It stands to reason that past experiences must have taught them that they received no injury from involuntary tumbles; that they have evolved the habit of voluntarily throwing themselves from an elevation in order to attain certain objects does not seem to me, therefore, at all wonderful or extraordinary.

TWO GIFTS TO FRENCH SCIENCE.

By M. HENRI DE PARVILLE.

M. ANTOINE THOMSON D'ABBADIE, of the Academy of Sciences and Bureau of Longitudes, France, who died in Paris, March 20, 1897, was born in Dublin, January 3, 1810, of a family of the Basses-Pyrénées temporarily residing in Ireland, but which returned to France in 1815. The d'Abbadies are said to have been descended from the lay monks instituted by Charlemagne to defend the frontier against the incursions of the Saracens. The name d'Abbadie was not originally a proper name, but the title of a function (*abbatia abbadia*), and designated those soldiers who lived in the abbeys of the Basque country, lance in hand. Hence the name, which is well diffused, whether spelled with two *b*s or one.

While still very young Antoine d'Abbadie manifested an unusual curiosity concerning the unknown around him. "What is there at the end of the road?" he asked his nurse. "A river," she replied. "And what is beyond the river?" "A mountain." "And what then?" "I don't know; I never was there." "Well," said he, "I will go and see." He was the same as he grew up, always wanting to know. He visited Brazil upon a mission for the Academy of Sciences, and on his return joined his brother at Alexandria.

Unknown Ethiopia attracted his attention, and he engaged with his brother Arnould in archæological researches. Archæology proved unfruitful, and the two brothers took up geodesy. For eleven years Antoine d'Abbadie traveled though Ethiopia, living the life of the natives, and making himself master of the five Abyssinian dialects. The exploration was difficult and sown with dangers. Antoine d'Abbadie covered the country from Massouah, on the shore of the Red Sea, to the interior of the land of Kaffa, which he was the first to visit, with a triangulation that involved the fixing of five thousand positions at five hundred and twenty-five successive stations. The distance between Massouah and Mount Wocho in southern Kaffa is

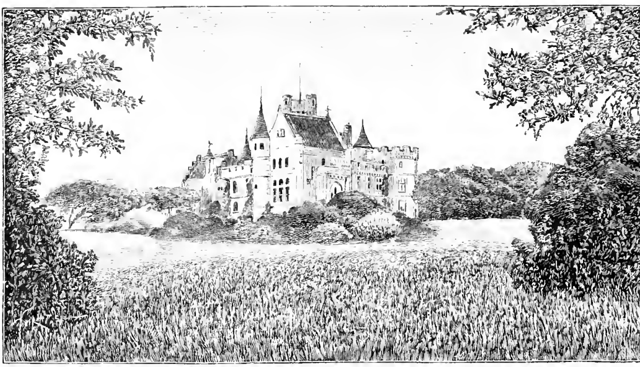


Fig. 1.—Château d'Abbadie. General view. (A gift to the French Academy of Sciences.)

about one thousand kilometres, a little more than the crossing of France along the meridian of Paris, and the trigonometric network reached two hundred and fifty kilometres in breadth. Antoine d'Abbadie remained in Gallaland from 1837 to 1848. The labors of the two brothers, too numerous to cite here, concerned also ethnography and linguistics. Both were nominated Chevaliers of the Legion of Honor on the same day, September 27, 1850. The doors of the Academy of Sciences were opened to Antoine d'Abbadie August 27, 1867, and he was named a member of the Bureau des Longitudes in 1878. He was in charge of the observation of the transit of Venus in Santo Domingo in 1882.

Instead of devoting himself to a specialty, as is done now to excess, d'Abbadie pursued the scientific movement in its various forms, and was at once an astronomer, geodesian, archæologist, ethnographer, numismatist, and interested in other fields. With his noble character he made himself esteemed and loved during his whole working life by all so fortunate as to make his acquaintance. In an interview I had with him a few weeks before his death, when his disease had already gained a strong hold upon him and he was nearly speechless, he expressed himself freely concerning the future, although he uttered every word with difficulty, and it was easy to see that it caused him pain. The topic was science, and he wanted to talk about it.

When he was president of the Academy of Sciences, a few years ago, he sacrificed himself to be equal to the honor that had been conferred upon him. Speaking was already becoming very difficult to his tired vocal organs. He made extreme efforts during the whole year to fulfill his duty as president, and was punctual at the Monday sessions to the end.

In 1896, feeling the advance of age, he determined to make a splendid present to the Academy of Sciences. The Duc d'Aumale had given Chantilly to the Institute. M. Antoine d'Abbadie gave the Academy of Sciences his magnificent Château d'Abbadie, near Hendaye, in the Basses-Pyrénées, on the coast of the Bay of Biscay. The academy will enter upon the possession of this property, of three hundred and ten hectares of land surrounding it, and of a capital producing a revenue of forty thousand francs (eight thousand dollars) after the death of Madame d'Abbadie. Only a single condition is imposed on the gift. Having carried on his astronomical work at Abbadia and begun there to catalogue the stars and study the variations of gravity, he asked in exchange for his incomparable gift that the academy should complete in fifty years a catalogue of five hundred thousand stars. The bureau of the academy dispatched its president, M. Cornu, and its perpetual secretary, M. Bertrand, to Abbadia as its representatives to express its gratitude to M. and Madame d'Abbadie. The faith of the academy was pledged to continue the work begun by M. d'Abbadie, and a commemorative medal was given him bearing on one side a portrait of Arago, and on the other a minute of the gift and the thanks of the company.

The Château of Abbadia will therefore be devoted to the determination of the stars that are not yet catalogued. Probably, as was the donor's thought, the religious orders or some of the secular priests will perform this colossal labor. The chaplain of the château has already given his service to the work. In any case, those who may live in the château will have no cause to complain of their home. Abbadia is a very interesting structure, built from plans by Viollet-le-Duc, modified and carried out by the architect Duthoit, with suggestions of the fourteenth and sixteenth centuries. The observatory adjoins the château, which it antedates thirty years in building, and has a meridian telescope and the essential astronomical instruments. In the deep cellar of the observatory M. d'Abbadie made more than two thousand seismic observations with the pendulum.

The château stands in an admirable situation, and presents a very fine external aspect. We give a general view of it and a picture of the main entrance. The interior decoration is very beautiful.

Those who have had the privilege of visiting Abbadia have remarked that a stone is missing from the balcony of one of the windows; this stone, according to the wishes of the donor, is never to be put in place. A history is connected with its absence. M. d'Abbadie, in the course of a journey in America, contracted a strong friendship with Prince Louis Napoleon, who was then in the United States. The prince once said to him, "If I ever come into power, whatever you may ask of me is granted in advance." The prince became Emperor of the French. Napoleon III had a good memory. He met his former companion one day, and said to him in an offhand way: "I promised when we were in America to give you whatever you would ask for; have you forgotten it?" M. d'Abbadie replied: "I have built myself a château near Hendaye, where I hope to spend the rest of my days. If you will be so kind as to go a few kilometres out of the way for me during your coming visit to Biarritz, I shall consider myself highly honored if you will lay the last stone of my house." Napoleon smiled and promised. But that was in 1870, and Napoleon III never returned to Biarritz. That is the reason a stone is missing at Abbadia.

FIG. 2.—PRINCIPAL ENTRANCE TO THE CHÂTEAU D'ABBADIE.

An account is also appropriate here of that other gift to French science and letters of the Château of Chantilly, made to the Institute of France in 1886, by the late Duc d'Aumale, whose tragic death in consequence of the terrible disaster at the Bazaar de Charité, Paris, occurred near in time to that of M. d'Abbadie. The duke was conspicuous as a soldier, as a man of letters, the author of the History of the Princes of Condé, and as a great bibliophile; as a member of the French Academy (1871), taking the place of Montalembert; of the Academy of Moral and Political Sciences, and of the Academy of Fine Arts; and as a patriot, though a banished prince. The gift was made three months after the decree was issued banishing the Orleans princes from France, and after the duke had expostulated with M. Grévy in vain against the step. The deed reads: "Wishing to preserve to France the domain of Chantilly in its integrity, with its woods, lawns, waters, buildings, and all that they contain—trophies, pictures, books, objects of art, and the whole of what forms,

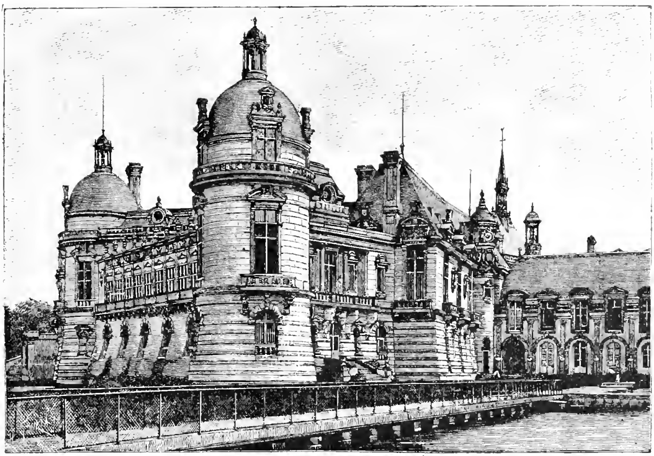


Fig. 3.—The Château of Chantilly.
(Presented by the late Duc d'Aumale to the Institute of France.)

as it were, a complete and various monument of French art in all its branches, and of the history of my country in its epochs of glory—I have resolved to commit the trust to a body which has done me the honor of calling me into its ranks by a double title, and which, without being independent of the inevitable transformations of societies, escapes the spirit of faction and all too abrupt shocks, maintaining its independence through political fluctuations. Consequently, I give to the Institute of France, which shall dispose of it according to conditions to be hereafter determined, the domain of Chantilly as it shall exist on the day of my death, with the library and the other artistic and historical collections which I have formed in it, the household furniture, statues, trophies of arms, etc." The sole condition attached to the gift was that nothing should be changed at Chantilly. The chapel, where the heart of Condé is deposited, should be retained, devoted to worship, with special masses to be said at stated times, and the splendid collections of the château should together be called the Condé Museum. In 1889 the Government authorized the duke to return to France. He refused to accept the permission as a matter of favor, but only as one of right. He returned, however, and took his seat in the academy in May of that year.—*Translated for the Popular Science Monthly from articles in La Nature.*

THE MONGOOSE IN JAMAICA.

By C. W. WILLIS,
MEMBER OF THE INSTITUTE OF JAMAICA.

ABOUT fifteen or twenty years ago the mongoose (*Herpestes griseus*) was imported from India by the colonial government and introduced into the island of Jamaica, in the West Indies, for the ostensible purpose of destroying the large, gray, white-bellied rat which played havoc with the growing cane on the sugar plantations.

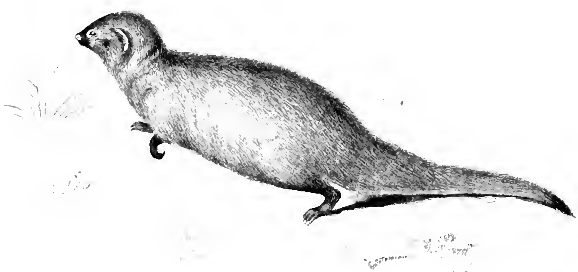
The mongoose belongs to the *Viverridæ*, or civet-cat family, which is closely allied to the *Felidæ*, one of the most widely diversified among the carnivora. But the mongoose differs materially from the civet cats, for it belongs properly to the subfamily *Herpestinæ*, or ichneumons, having toes slender and straight, and separate from one another; the scent glands, so highly developed in the civet cat, being either small or entirely absent. Most of the ichneumons are natives of Africa, but several are Indian, and one form (*H. ichneumon*) extends to southern Spain.

H. griseus is the true mongoose of India, and is the animal imported into Jamaica. In its native habitat it devours snakes, rats, lizards, and other creatures not in favor with humanity. Its color is gray, darker on the head and legs; its feet are blackish, and the end of the tail is tipped with black. Beneath the longer gray- or white-ringed hairs there is a fine, short, reddish under fur. The body of the full-grown animal is about twenty-one inches in length, and the tail eighteen inches.

Like Pharaoh's rat in Egypt, to which it is allied, the mongoose is highly valued in India, and is often kept tame about the houses for the services that it renders in destroying snakes and other plagues. It is especially famous for its prowess in destroying the deadly cobra, a feat performed by force of its superior boldness and activity.

That the little animal has fairly achieved the object for which it was imported can not be gainsaid, but that it would ever become the universal pest which it is at the present day, and has been for several years, was never anticipated. So long as it kept to the cane-growing plantations, and ate the planter's poultry and all young and available animal life, all went well; but with its rapid and prolific powers of reproduction and its vagabond and roaming disposition, in a very short time it was found to be in every part of the island, from the seashore to the tops of the loftiest mountains, the highest peak of which is seventy-three hundred feet above the sea level.

Though it has not exterminated the cane rats, it has lessened their numbers, and saved the sugar planters a vast sum of money. But it has nearly exterminated the ground laying and feeding birds. It



THE MONGOOSE (*Herpestes griseus*) IN JAMAICA.

devours poultry and eggs of all kinds, on the ground and in trees, including those of the land turtle, so that the latter, once very numerous and highly esteemed as an article of food by the native epicures, is now seldom found. Here may be mentioned an interesting fact, that the mongoose, in no way a tree-climbing animal in its native India, has become such in Jamaica, as its voracious appetite lessened the numbers of ground feeding and laying birds, and compelled it to take to the trees in order to enlarge its food supply.

The mongoose kills young pigs that roam, half wild, over the island; also lambs and kids. It eats fruits of all kinds, fish, wild fowl, snakes, lizards, and crabs; and the once plentiful edible lizards and land crabs are now rarely seen. All young and tender life, both animal and vegetable, is included in its daily *menu*. When the mongoose has cleared off all the animal life, it turns its attention to the "ground provisions," and here it shows the varieties of its tastes and the strength of its jaws. It will grovel with its paws until yams, cocos, sweet potatoes, cassava both bitter and sweet, and other ground food tubers are laid bare.

Of fruit, the mongoose has a partiality for bananas, the mango, and others, as well as for some of the tree vegetables, such as the delicious akee (*Cupania edulis*), and the avocado, or alligator pear. It will, likewise, when the irrigating canals are drained for cleansing, seize fish and make off with them. Not the least harm it has done has been the destruction of insectivorous birds and lizards, and the consequent increase of another nuisance, the tick. This is a subject which the Jamaica Government is bound to take up in the near future, and there will be found only one remedy—the introduction, propagation, and protection of insect-eating birds, for the question of adopting some plan for the wholesale destruction of the mongoose has thus far proved fruitless.

The mongoose breeds six times a year, and each time there are from five to ten young ones. The animal lives in the hollows of trees, dry walls, and other similar places. Its activity is wonderful, and it very seldom misses its quarry, which, when secured, the mongoose proceeds to mutilate in the groin, first of all drinking the warm blood, then devouring the liver and heart.

In Jamaica there was a very beautiful indigenous snake (*Chilobothrus inornatus*), a friend of the agriculturist, commonly called the yellow or banana snake, which grew to a length of six or seven feet. It is practically extinct, for during the last five or six years it has been nearly impossible to find a specimen. This bloodthirsty little animal has also nearly exterminated another ally of the cultivator, a certain ground lizard (*Anolis corsalis*), which is now very rarely seen.

In its general appearance, except in point of size, it being much larger, it may be stated that the mongoose very closely resembles the common gray squirrel of the northern United States, although the latter does not have feet and tail tipped with black.

Comparing the flint implements of palæolithic and neolithic age, Prof. T. McKenny Huse exhibited at the British Archæological Institute a series of flints to illustrate his view that in their earlier stages of manufacture the palæolithic and neolithic implements passed through the very same steps —that is, a block of flint was first rough dressed by both palæolithic and neolithic people into the same general form. The neolithic man merely proceeded further on the same lines, afterward finding out the way to grind the edge, and at last the whole implement. With few exceptions, the author said, neolithic flints were found on the surface or in artificial excavations; whereas, as a rule, palæolithic implements were found in deposits that seemed to be due to the sweeping down into hollows or river terraces of surface soils in or on which the implements and other stones lay.

THE CAUSE OF RAIN.*

By J. R. PLUMANDON,
METEOROLOGIST AT THE OBSERVATORY OF THE PUY-DE-DÔME.

A GREAT many theories have been invented to explain the formation of rain, some of which are remarkable chiefly for their absurdity or their complexity. Even most of the scientific theories depend too largely on hypotheses and are not sufficiently supported by facts. There are, however, some which are as a whole established on authentic observations, and, although they are still incomplete, they do not, like some of the speculations, contradict facts that are observed every day. For more than thirty years I have studied professionally and because I had a taste for it all the atmospheric phenomena which came before me. Several times I have been so fortunate as to witness, at Clermont, or on the top of the Puy-de-Dôme, the genesis or development of heavy showers, and have fancied that I have detected some of the details or secrets of their formation. In a pamphlet on this subject, which I published in 1885, I expounded the ideas which a large number of observations on fog, drizzle, mist, rain, snow, sleet, and hail had suggested to me; and by means of some of these ideas, the resultant of facts observed hundreds of times, I hope to be able to explain the formation of rain.

First, I must say that heat, and especially moisture, do not vary in the lower part of the atmosphere in the way it was long thought. At extreme altitudes the temperature of the air is very low, but the cold does not increase regularly as we rise, and the same is the case with the moisture. In high ascensions, or while sailing almost horizontal courses, aëronauts traverse atmospheric regions alternately warm and cold, dry and moist. Such anomalies present themselves even near the surface. There are between eighty and a hundred days every year in which a higher temperature is registered for a greater or less length of time on the Puy-de-Dôme than at Clermont. Sometimes the difference is very great. Thus, on the 26th of December, 1879, the temperature was $-16°$ C. at Clermont, while on the summit of the Puy-de-Dôme the thermometer marked $+5°$ C., showing a difference of 21° in favor of the top of the mountain. Differences of temperature of this kind occur everywhere. The moisture of the air varies in the same way through the atmosphere. In ascending or descending a few hundred metres, the hygrometer may be observed to pass from dryness to saturation. At the altitude of the Puy-de-

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Dôme extreme moisture may succeed almost absolute dryness in a few instants, in a clear sky and without any change of wind.

The parts of the atmosphere included within the same limits of temperature or humidity therefore rarely form concentric or parallel layers. They constitute regions interlacing zones which the clouds, thick or scattered in groups, often mark to our eyes, showing us those which are saturated with the vapor of water. The distribution of these zones in space depends chiefly on the heat action of the sun, and upon preceding and present movements of the atmosphere. Now, if a certain increase of heat is adequate to melt a piece of ice and to transform the water of the fusion into vapor, in like manner a corresponding cooling may suffice to cause the vapor to return to the state of a liquid and then to that of ice. The processes in the atmosphere are not different, and all showers, results of the more or less extensive condensation of the vapor of water, may arise from the cooling of that vapor or of the water which it produces.

A certain volume of atmospheric air is capable of holding in suspension a quantity of water proportioned to the elevation of its temperature. But, for each determined temperature, there is a maximum which can not be exceeded without the excess of vapor returning to the liquid state. If, therefore, an atmospheric region is saturated with vapor, and its temperature falls, that region will give rain. Immense and superabundant causes for the cooling necessary to provoke rain exist in such an atmosphere as we have described. The cooling may take effect in three principal ways: first, by the radiation of different regions between one another and toward interplanetary space, the temperature of which is extremely low, as has been indicated by measurements made in high balloon ascensions; second, by the expansion which air rising in the atmosphere undergoes in being rarefied; and, third, by the mingling of masses of warm or moist air with cold or dry.

Cooling by mixture is the sufficient cause in the majority of cases; and this may be effected from above, by descent of the air from the upper regions; from below, by ascent, with the assistance of rising currents created by solar radiations; or, finally, in any and every direction under the influence of the winds and the general movements of the atmosphere. Furthermore, the cooling need not be very great in order to provoke rain under certain conditions of temperature and humidity of frequent occurrence.

Rain clouds very frequently descend a little below the altitude of the Puy-de-Dôme. It is, therefore, not difficult, in order to determine the degree of cooling necessary for the formation of rain, to take advantage of observations that have been made there. The hygrometer sometimes remains near saturation without there being precipitation of vapor; and, supposing that the temperature is near 3° or 4° C., which is about the mean temperature of the year, it will require a cooling of only one or two degrees centigrade at most for the air to be unable to hold all its vapor and for the excess of it to be transformed into rain. This is confirmed by experiment and observation.

I will mention a remarkable example illustrating this point. Not rarely, when the west wind is blowing violently on the top of the Puy-de-Dôme, an east wind, blowing opposite to it, prevails at Clermont. Then an eddy is formed behind the plateau and the chain of puys that runs from north to south, a little west of Clermont. This eddy gradually becomes a vast whirlwind with a horizontal axis, several leagues long, a few kilometres wide, and seven hundred or eight hundred metres high. It commonly gives rise to an abundant and continuous formation of black clouds, which appear in an instant along its length, following its intersection with the upper current. The phenomenon is frequent, and is sometimes produced under very interesting conditions, as on a certain day when the temperature at Clermont was five degrees above zero, centigrade, while the hygrometer indicated that the air contained seven tenths of the quantity of vapor required for saturation. Under such conditions the temperature on the Puy-de-Dôme would have only had to be a very little above the freezing point for the vapor of the horizontal eddy to be transformed into rain on meeting the upper current coming from the west. Now, on the top of the mountain the thermometer marked 4° C. below the freezing point. Hence, every time the lower east wind increased a little, this having the effect of carrying the vapor and the air of the lower regions a little higher, the black clouds could be seen developing with a recrudescence of intensity. A few instants afterward a torrential rain fell at Clermont.

In some cases—and such frequently occur in summer—the mingling of strata of air of different temperatures is effected by ascending currents. The sky is clear; the moist air in contact with the soil is warmed under the action of the sun, rises, and more or less quickly reaches a much colder stratum. Light mists are formed; they may frequently be seen rising and spreading out over the warmer or moister spots. On the flanks of the Puy-de-Dôme one may often find himself among ascending currents of this sort which succeed one another intermittingly when the air is calm, after a rain; they rise with a velocity of four or five metres at least per second.

These fogs finally become stationary in a region of the same density with themselves. There they accumulate and form a cloud or a group of clouds that go on developing. When penetrated by the rays of the sun, which they almost wholly absorb, these clouds are warmed up again in the interior, and budding protuberances are seen, which are especially developed on the upper parts of the cloud. These protuberances are formed and grow so rapidly as to almost suggest the presence of a steam generator within every cloud. The external parts of the cloud, however, cool very soon by radiation, evaporation, or dissolution, but especially by their contact with the cold air, into which they continue going. Hence, when the vapors emitted by the cloud reach its periphery, they are cooled at once as if in a condenser; they then take on a rapid movement of descent, which is easily distinguished, and suffer condensation in their lower parts. As the surface of the cloud in contact with the cold air around it is considerable in proportion to that which receives the influence of the solar rays, the warm ascending currents slacken speed and are extinguished, because the cloudy mass, drawn on by the higher currents, removes from the place where it is formed, or because it stops the rays of the sun and prevents their reaching the ground. There results a more and more complete condensation, and the watery vapor is at last transformed into drops of rain. The condensation into rain is accelerated and augmented when the mass of cloud rises with great rapidity, especially when it enters abruptly into very cold atmospheric strata. A sudden mixture of the cloud with the air around it takes place then, and sudden and abundant rains result like those which are produced at the instant of thunderstorms.

The formation and mixture of masses of air of different temperatures are effected by ascending currents in zones of restricted extent, but sometimes very numerous. Local showers and thunderstorms are produced in this way. The phenomenon becomes much more important and at the same time extends over vast regions, when it is brought about by the aid of the wind and the larger movements of the atmosphere, and general rains result.

Babinet, in his Studies on the Sciences of Observation, explains the formation of rain by supposing that when the wind meets an obstacle, it ascends; the moving air cools in rarefying, and deposits its excess of vapor over saturation. This fact, when it occurs, should indeed contribute to the condensation of the vapor contained in the air; but it does not afford an adequate explanation of all rains; for, first, how can it rain on the vast oceans which present no obstacles to cause the air to ascend? It is necessary to suppose that internal movements of the atmosphere intervene in the production of rain.

Monk, Mason, de Saussure, and many others fix the prime condition for the formation of rain in the superposition of two beds of cloud. This assertion, although it is still repeated in a number of treatises on physics, is inexact. A single stratum of cloud—yes, a solitary cloud—has been seen, on the Puy-de-Dôme, to produce rain and lightning, with thunder.

Frequently, under the influence of the centers of perturbation which often exist south of the Alps, a vast sea of clouds, the upper face of which does not exceed an altitude varying from seven hundred to twelve hundred metres, covers all central France, and probably other countries. Only the high table-lands and mountains rise above this stratum of clouds over which the sun shines in a perfectly clear sky. Yet rain is found in such strata of clouds, however homogeneous they may be, and it rains in the regions they cover. I have long been able to affirm this fact, important because it destroys old errors elaborated in the isolation of the study, and to support it with authentic proof.

We may witness the formation of rain when we rise into the usual region of the clouds, either in balloon ascents or by climbing mountains.

The phenomenon may be observed under five aspects: First, we may find ourselves in a fog of greater or less thickness, the hygrometer indicating that the air is nearly saturated with vapor, without one being able to detect the fall of the smallest liquid particle, and without exterior objects being moistened. Second, while we can not observe the fall of a single liquid drop, however small, everything enveloped in the cloud will be rapidly moistened. We are in the atmospheric stratum where the rain is beginning to form. Inhabitants of mountainous regions say at such times that there is a wet fog. At the top of the Puy-de-Dôme, when this condition lasts for a day, we can collect three, four, or five millimetres of water. Third, we may remark, in the fog, the fall of exceedingly fine droplets, which we can hardly distinguish—it is drizzling. Fourth, the rain is falling, while we are still in the fog; and, fifth, the rain is falling and we are below the fog—that is, below the clouds.

These five aspects may be present in the same cloud, when we will find them in the order given in successive strata, one beneath another; so that, entering such a cloud from the upper part, we may traverse, in regular order, "dry" fog, wet fog, fog with drizzle, fog with rain, and, as we leave the cloud at the bottom, rain without fog. Mr. Glaisher, the English scientific aëronaut, thus records his experience in an ascension he made July 1, 1863: "We let ourselves drop at eight hundred metres, and went into a fog which was dry for the first thirty metres, but shortly afterward became moist. As we descended, the fog seemed to become more charged with water, and seemed very dark beneath us; at five hundred or six hundred metres we heard the sound of the rain striking the trees, so violent was the fall."

Rain drops, in fact, grow as they fall, whether by continuance of condensation, or by union with other drops. They should, therefore, be larger when they issue from the cloud in proportion as the region where drizzle is formed is higher above the base of the cloud. There is, however, a limit to the size they can attain, for the velocity of their fall increases with their mass, and they are divided by the resistance of the air.

The five aspects under which we have regarded the formation of rain are evidently five phases distinguished by our senses in the progressive transformation which the vapor of water undergoes in passing to the liquid state. It also sometimes happens that the condensation of the vapor in a cloud can only reach the first or second stage of the transformation without extending to the other stages. At other times it stops at the third phase, that of drizzling, which may then, as rain does, cross atmospheric regions below the cloud, and reach the ground, provided the base of the cloud is not too high and the air passed through is not too dry. In short, we may conclude that the formation of rain is due simply to variations in the temperature and moisture of the air. There is, however, another element, the intervention of which is indispensable, if not to reduce the vapor to water, at least to cause that water to fall in rain, or under the form of drops. This element is the atmospheric dust.

We designate generally as atmospheric dust all the corpuscles which the atmospheric envelope of the earth holds in suspension; but distinctions should be made. Some dust occurs in the air fortuitously and for the moment, such as troubles us in dry weather when the wind is blowing. This is coarse, and so evident that we say "It is dusty," and soon falls by its weight to the ground. There is other dust which remains in the air almost permanently. It becomes visible to the eye when illuminated against a dark background, as when a sunbeam comes into a dark room. Other dust may be studied under a microscope of low power; and still other, and the largest proportion of that in the atmosphere, is so fine that it can not be distinguished, even with the most powerful instruments.

This extremely fine and light dust is disseminated to heights that may exceed fifteen or twenty or more miles. Cyclones, volcanic eruptions, and immense prairie fires are the principal causes of its production and expansion in the atmosphere. Mr. Aitkin, a Scotch meteorologist, has made some remarkable experiments to demonstrate the existence of this dust. For that purpose he employed a very ingenious method, which permitted him to count all the particles, even those which could not be seen with a microscope. The principle of his method is as follows: If we fill a receiver with air that has been deprived of all its dust by passing it through a liquid, and saturate it with vapor, and then by cooling cause the vapor to condense, the resultant water is deposited directly. If the receiver is filled with air not cleared of its dust, the cooling of the mixture of air and vapor provokes first the formation of a fog that marks the presence of dust, because each particle of dust becomes a nucleus, a center of condensation, for the vapor. Finally, if the cooling is carried far enough, the water formed falls in very fine droplets, each one of which incloses a dust particle. Mr. Aitken has succeeded in counting these droplets, by introducing only a very small volume of dusty air into the receiver and finally filling it with absolutely pure air. He has thus found that the external air contains on the average 32,000 particles of dust per cubic centimetre after a rain of considerable duration, and 130,000 particles in fine weather. There are 1,860,000 particles in the same volume of air in the middle of a room, and 5,420,000 particles near the ceiling. The figures look fanciful, but they are exact, for they have been corroborated by numerous consistent experiments and agree with the determinations that have been made by other methods.

As to the formation of rain, it should be observed that absolutely pure air can not give either fog or drops of water when it is supersaturated with vapor. If there were no dust in the atmosphere we should have no clouds or rain. The sky would always be clear, and the sun would shine uninterruptedly as long as it was above the horizon. There would be no dawn or twilight, and day and night would succeed one another instantly, without transition. Atmospheric water would be deposited only when in contact with things, as in Aitken's experiments, very much as dew is deposited.

The causes of the formation of rain are evidently the same everywhere. The secondary conditions change only according to climates; but they vary so much that rains are distributed very unequally over the earth. According to Desanis, the quantity of vapor contained in a column of air as high as the atmosphere would give, in France, a layer of water about four centimetres thick. Few rain storms would furnish so much; but there are storms sometimes that give much more. On August 17, 1888, seven centimetres of water fell at Clermont in five hours; and September 12, 1875, the pluviometer measured ten centimetres for the whole day. Still more copious rains fall in some tropical countries; at Purneah, in India, eighty-nine centimetres have fallen in twenty-four hours.

Mr. John Murray has calculated, from the charts of Elias Loomis, that the quantity of rain falling every year over the whole earth would form a bed of water averaging nine hundred and seventy millimetres in depth.

When we consider the annual quantities of rain in particular regions or localities, we find the numbers exceedingly variable, and some of them surprising. Clermont receives 630 millimetres, and the mean of the fall in Europe is about the same. About one metre falls on the western coast of Iceland, two metres in Norway, 2.80 metres in Scotland, 4.60 metres at Vera Cruz, 5.20 metres at Buitenzorg, in the Dutch East Indies, 7.10 metres at Maranhão, Brazil, and 12.50 metres at Cherrapunji, in British India. On the other hand, it rarely rains in some regions of the globe north and south of the equator; as in the center of the Sahara and of Arabia, the plateau of eastern Persia and Beluchistan, the desert of Kalahari, and the desert of Atacama. The plains or pampas of the eastern slopes of the Andes, in about 23° south latitude, are likewise subject to extreme droughts, in one of which, lasting three years, three million head of cattle perished.—*Translated for the Popular Science Monthly from Ciel et Terre.*

DREAM AND REALITY.

By M. CAMILLE MELINAND.

THERE is a very striking resemblance between dreams and waking perceptions. We see in dreams objects, persons, and events identical with those of the waking state. The belief in their reality is as complete as in that of what we see when awake; the emotions are as deep and vivid. Pleasures have a delicious savor, and pains are even more intense than those of the reality—as, for instance, those of nightmare, and the distresses to which we give ourselves up in full. In all cases these dream troubles seem as real as those of life, and are taken by us quite as seriously; and the existence of everything we see and feel is as evident as in life.

Still we oppose the dream to the reality. The waking world is our true, our only world; the world of the dream seems to us purely interior and chimerical. The incoherence and absurdity of our dreams surprise and amuse us, and we are amazed to find that we have been able to believe, while asleep, in such foolish things. In short, dreaming is synonymous to us with illusion, phantasmagoria, and falsehood. The clearest of the prevailing theories about dreams rest upon the postulate that waking perceptions are the true ones, and the visions of the dream are false. They have answers to the three questions we are used to ask concerning dreams—Where do they come from? why are they incoherent? and why do we take their visions for realities? They explain dreams as former sensations reviving within us under different combinations, and as therefore simply confused reflexes of the reality. Dreams may, however, sometimes be produced by a present impression suffered by one of our senses, half awakened—a contact, the way we are lying, and the condition of the organic functions being thus the causes or occasions of dreams. The incoherence of dreams seems no more mysterious in these theories, and is explained as the result of two causes—the slumber of the "reflecting" faculties, judgment, reason, the will, the exercise of choice and control; and, secondly, the unrestricted reign of imagination and the association of ideas. Our faith in the reality of the things dreamed is accounted for by the mechanical play of the images, the law being set up that every image that is not opposed by stronger images appears to us a real object. The problem, therefore, resolves itself: the senses being asleep, the images that arise within us are not contradicted by normal sensations, and that is why we take them for realities. Further, our reflective faculties, being likewise dormant, can not contradict the images, in the absence of sensations, reasonings, or recollections. Hence a credence, as absolute as unreasonable. We purpose to show that there is something artificial and prejudiced in the classical theory of opposition between dreams and waking, which assigns illusion, confusion, and incoherence to the former, and solid and permanent reality to the latter, and that the difference between them is not so clean cut.

Most persons in talking of this subject say that they are sure of the reality of things when awake because their different senses concur in attesting it. They see a tree, and satisfy themselves that it is a tree by going up and touching it. They smell a rose, and go find the rose, look at it and handle it; while in dreams we are not able to apply these supplementary tests. The distinction is imaginary, for our senses likewise seem to support one another in dreams. We dream not only that we see an object, but also that we feel and hear it. When I dream of meeting a friend, I believe that I see him and shake hands with him and hear him speak. There is, therefore, a complete identity of the two conditions as to this point, and the thing that appears to me in a dream is a "bundle of sensations," visual, tactile, auditive, muscular, and often olfactory, just as it appears to me when awake.

We are told of another difference. When awake, we find others agreeing with us in recognizing the reality of things. I see a tree, and so do those with me; I show it to them, and they look at it; I feel of it, and they touch it; I hear the rustling of the leaves, and so do they. Our perceptions in practical life are thus tested by comparison with those of others, whereas in our dreams we have our solitary and fanciful visions all within ourselves, with none to participate in our perceptions of them.

This supposed contrast is no more real than the former one.

What is true is that when we are once awake we change our point of view, and our vision of the night then seems to have been wholly interior, solitary, and subjective. But, notwithstanding the common illusion, *while we are dreaming* affairs pass, to us, exactly as when we are awake. It is true that in the waking state we find ourselves mingled with other men, who perceive the same objects that we do. Do we not sometimes dream that we are one of an audience looking at a play? that we are talking with a friend, and exchange views with him? and that we understand one another perfectly? There is, therefore, in this aspect, not a difference but identity between the dream and the waking. The interior condition, the sensation, the credence, are identical. The dreaming man believes, sees, and feels himself in intercourse with his fellows, just as the man awake believes, sees, and feels it. When we wake, we discover our mistake, but what of that? It does not prevent us from believing completely in it while we are asleep. And this is the point; for, after all, am I sure that I shall not awake some day from what I now call my waking life? And who knows whether I shall not then judge that I have been dreaming a solitary dream? It may be added that the agreement of witnesses is not a decisive sign by which to distinguish the reality from the dream. There are collective hallucinations.

We come now to a more important difference, which includes the principle and has a characteristic apparently essentially distinguishing the dream—its looseness, disorder, inconstancy, and incoherence. In the dream visions succeed one another without connection; no law determines their order; an unrestricted fancy reigns among them, and the normal is broken up in them at every point. We are transported instantaneously from one country to another. We pass without transition from childhood to age, and causes have the strangest effects. The most essential laws of thought are constantly violated. There are facts without any causes, metamorphoses, magical disappearances. Even the absurd is realized, and the "principle of contradiction" does not seem to be any more respected than the others. We are at the same time in two places; we pronounce words, we hold conversations of which we can not when we wake recover the thread, so strange is their logic, so fugitive the sense, and so fanciful the combination. A practiced psychologist, M. Delbœuf, succeeded in taking down in the morning the last phrase of a book which he had been reading in a dream, and which had seemed then remarkably lucid. Here it is: "The man raised by the woman and separated by aberrations pushes facts disengaged by the analysis of the tertiary nature into the way of progress."

Is this distinction, then—that the dream is incoherent and the real rational—any more just than the others? It is doubtful if it is. There are rare dreams in which everything proceeds in a regular and natural way; and, on the other hand, reality is not always exempt from capriciousness and improbability. But to me the capital objection to the distinction is that it is illusory, and the contrast between the disorder of dreams and the coherence of the real is only apparent. The dream, it is true, appears disordered to us, but that is when we are awake. An essential point which we always ignore is that *while we are dreaming* everything seems simple and normal and regular to us. We are not at all astonished at what happens. We find it all right to be in two countries at the same time, and we undersand very well how one person can be changed into another. The conversations we have—those which are utterly unthinkable when we are awake—usually appear to us marvelously lucid, and we admire the ease, the *verve*, and the luminous continuity of our words. We enjoy that moving with so much suppleness and precision among ideas; our demonstrations are infinitely convincing; and it is perhaps in the dream that we have the most perfect sense of evidence.

Everything, then, that passes in the dream is—to the dreamer—as natural as events in the waking condition. When awake, events seem, without exception, natural and regular; they also seem natural and regular in the dream. It is true that we find them absurd when we wake, but what of that? They are absurd only by comparison, as looked at from the point of view of the waking man, who is no longer the same that he was when dreaming. Who can tell if we shall not awake some day from what we now call our waking condition, and that we shall not then find the events absurd that we now consider rational and real? Who can tell that we shall not be stupefied at having been so firmly attached to invisible phantoms and disordered combinations?

In setting up a fourth distinction it is said that real life forms a continuous whole, while dreams are not connected with one another. The series of my days forms a single life, which holds together. I resume to-day my life of yesterday, and shall resume tomorrow my life of to-day. While I am asleep, the course of it is only suspended. I begin again in the morning at the very point where I stopped in the evening. I find myself in the same medium, occupied with the same thoughts, subject to the same cares, involved in the same routine of events, the same storm of passions. The same thread runs through it all. On the other hand, it is said, our dreams do not form a consecutive existence. The dream of one night has no connection with the dream of the previous night. On going to sleep to-night I have no assurance that I shall find the landscapes or the personages or the circumstances of my last dream. The most diabolical nightmare may succeed a most delightful romance. In short, not only is the form of the same dream incoherent, but our successive dreams are incoherent as to one another. This was what struck Pascal when he wrote: "If we dreamed the same dreams every night, we should be affected by them as we are by things we see every day; and if an artisan was sure to dream every night, for twelve hours, that he was a king, I believe he would be nearly as happy as a king who dreamed every night, for twelve hours, that he was an artisan. . . . But because dreams are all different, and the same one is so diversified, what we see in one affects us much less than what we see when awake, because of the continuity of the waking life, which is not so continuous and even, however, but that it changes, too, though less abruptly, if only rarely, as when we travel; and then we say, 'It seems like a dream to me,' for life is a somewhat less inconstant dream."

What are we to say to this distinction? I do not believe it is necessary to take it seriously, any more than the others. When is it that we pass judgment on the discontinuity and incoherence between our successive dreams? Not while we are dreaming them. When I am dreaming, I seem to be pursuing a life that has always been the same. I have no sort of an impression that the present dream has been preceded by different dreams having no connection with it. I have, on the contrary, exactly as I have when awake, the impression of an indefinite and single series of events, of an unrolling of them without arrest and without break. There is, therefore, on this point, no difference, but another resemblance between the dream and the reality, and the same impression of continuity and unity prevails in both. It is true that the aspect changes in waking, and our several dreams then appear detached from one another. But what of that? Are we sure that we shall not awake some day from what we now call the waking state, and find then that that state, continuous in appearance, was in reality composed of a series of separate, incoherent, and incongruous fragments?

Thus we are all the time coming upon the same illusion. We judge of the dream, not by what it is, but by what it seems to have been after we have waked. Instead of observing the impressions of the dreaming man while he is dreaming, we take notice of what he thinks about them after he has waked up. This is to falsify the comparison of the normal and dream life by regarding the normal life while we are in it, and the dream life when we have come out of it. The several other difficulties on which psychologists have insisted are capable of solution by the application of the same principle: the seeming suspension of the will; the want of correspondence of the moral standards of the dream with those of the waking condition; the confusion of temporal duration and sequence; and the transformations of personality and character, concerning which I would ask, however, if the eccentricities betrayed are not rather in the nature of more complete exposure. I have sometimes been surprised at the psychological revelations of dreams; faults and weaknesses that we do not avow when in the normal condition reveal themselves then with inexorable frankness; we yield to temptations that we evaded when awake, though inclined to them; to wickednesses which we kept closely shut up within us; reveal antipathies which we had dissimulated. Base desires break out, latent loves declare themselves, and things take place which, as in a play, bring the farthest depths of our hearts into the light; and when we wake we say: "That is true; it is just what I should have done under like circumstances. I had never thought of it, and I am not proud of it, but it is so."

There is this real distinction between the dream and the waking state: that when awake I know there is another condition, while in the dream I take no thaught of the waking state. Awake, I know that I have been living the fantastic dream life, and have come out of it into a real life completely distinct from the other. I am in a first state, and know there is a second. But when I am dreaming I have no thought of another state that I have come out of and must return to; I do not feel that there is another existence, radically separated from this one; and I never compare the visions of my dreams with my waking world, for I know nothing of it. I have the impression of having always lived the life I am in, which seems natural; and even if I ask whether I am not dreaming, it is a merely verbal expression, with no accompanying sense of the meaning of it. Another distinction, and the only absolutely clear one, is that while we always wake from the dream, we never wake from the reality. This is why we believe in the reality and not in the dream.

These two differences are differences in degree, but they do not necessarily indicate differences in nature. Similar facts are frequent among hypnotics. We may plunge them into a condition of somnambulism which we will call a second state; and then, from that, magnetize them over again into another somnambulism, which we call the third state. Now the curious fact comes to pass that the subject in the third state recollects the second state, but when in the second state again, knows nothing of having been in the third state. "Lucie 3," says M. Pierre Janet, "recollected her normal life perfectly; she also recollected previous somnambulisms, and all that Lucie 2 had said. . . . It was a long and hard task to awaken this subject after she had passed a few minutes in the syncope already described. She then returned to ordinary somnambulism, but Lucie 2 could not tell me a word of what had happened to Lucie 3, and supposed she had been asleep and said nothing." Thus we have the same difference between two successive stages of somnambulism as between the dream and the waking state. But as the stages 2 and 3 are evidently of the same nature, so we have a right to suppose that the dream and the waking, whose phenomena as to each other are similar, are likewise of the same nature.

In the ordinary experience of mankind we do not awake from our normal condition; but is it proved that there is never any awakening, any third state into which we may pass? The supposition of some such state into which we pass by death is one of the fundamentals of nearly all religions; and in this sense we might contemplate the possibility of an awakening in which we shall be astonished at having given ourselves up so completely to the world of sense, at having taken a passing state for the definite one, an ephemeral world for the sole and absolute world, a provisional existence for the real one.

Even among men as we find them, we see some making an approach to a third state, if not living in it. What is science but the revelation of a new world, different from the visible one? When we see light and colors, they tell us of an invisible ether with particles vibrating with almost incalculable rapidity; when we hear faint or loud sounds, sharp or grave, they tell of the more or less ample and rapid vibrations of matter. When we perceive a multiple or varied reality, it shows us the single phenomenon of motion. These formulas do not, however, signify, as some mistake, that light, color, and sound do not exist, but that there is something else; and that if we could gain new senses, a new universe would open out to us. This means, simply, that the scientific man is already half waked up from his ordinary life, and has half entered a new world.

Metaphysics is a waking up of this kind. A metaphysician who really believes his doctrines, like Plato or Spinoza, is already living in a new world and contemplating the supposed reality in which we are still immersed as a matter of indifference away off in the dim twilight. To him, what we regard as reality is only appearance, while the eternal rain of atoms or the play of immaterial forces, or whatever he supposes the world to be made of, is the true reality.

Religion is another such awakening, and to the devout man this life is only a provisional one, a trial, the prelude to the true life; and while he may regard the world of sense as real too, he looks forward to the superior reality, which it is the privilege of the elect to contemplate; and it is some feeling of this kind that has sustained martyrs and has incited men of all ages and all faiths to suffer and endure, and die for what they believe.—*Translated for the Popular Science Monthly from the Revue des Deux Mondes.*

A PRACTICAL DUTCH CHARITY.

By J. H. GORE.

HOLLAND, Scotland, and Switzerland, quite unlike physically, have in their institutions many points of similarity, and the impulses and character of their people are almost identical. In religious matters the resemblance is also striking, even though the creed professed be known by different names.

In Scotland the struggle for existence demands something more assertive than the doctrine of *laissez faire;* the terrible sweep of the avalanche in Switzerland, without any apparent cause for its starting, suggests an acceptance of the belief that "it is, because it must be"; while Holland, in its incessant war with the sea, is continually bidding defiance to natural laws, and protesting against their unrestrained action.

Calvinism found its strongest adherents in the two countries first named, and the faith of Luther answering to the active instincts of the Batavian race was at once adopted by it. In Holland as well as in Switzerland man is ever reminded of life's realities by the watchful care necessary for his very existence, and the material obstacles which must be conquered at every step. Patriotism never becomes dormant because the face of the land shows in its scars its history, and love for home grows with each reckoning of the cost of its retention. The possessions of one day are in many instances no guarantee of the wealth of the next, and the hand now extended in giving assistance may on the morrow be held out to receive. Thus we find the charitable instincts always awake, and societies for the relief of the needy thoroughly organized.

The conditions under which Holland began its geographic formation and the processes afterward employed to hold or enlarge her boundaries, together with the social unrest of the time, caused thoughtful men to put in operation every agency that could direct the innate desire to do good and to give direction to the forces within the kingdom, as well as those which came from without. In Holland, therefore, we find numerous societies for the relief of suffering humanity, and people ever ready to give due attention to the complaints and necessities of the laboring classes. No other country offers such an excellent field for the study of charitable institutions. The Dutch are eminently practical; they made an early beginning in the work of alleviating distress, and this relief, from the nature of things, as pointed out, is not spasmodic as in other countries where nothing short of famine, earthquakes, or floods can awaken the people to a realization of the duty they owe to mankind. Here the call for aid may come at any time, so that those charitably inclined must be ever ready to respond, and the organizations for relief can never become lax or inefficient.

Then, too, the population of the Netherlands is very homogeneous, and the leaders in all good works are not only administering to their own people, but are unbiased by prior experiences under other auspices. Consequently, this country furnishes institutions organized under normal conditions, with an entire absence of external influences, and where the helped and the helpers are of the same race.

England, France, and Germany have sent commissions to Holland to study its organized charity, its school system, workingmen's societies, and like institutions. These countries have but little in common, even though their forms of government are, or have been, outwardly similar, while on the other hand we have always found in the Dutchman "a friend and a brother," and an example well worthy of following. And since it is only after examining remedies for evils found without complications, that we can prescribe for abnormal conditions, the study of Dutch institutions is the best possible preparation for arriving at the means for meeting the necessities in our own country.

In Holland the general awakening to the demands of the people came in the eighteenth century, when the social life was lacking in strength, when the rich were largely given over to extravagance, while the poor were neglected, uneducated, and exposed to want. Everything seemed to separate the two classes—nothing emphasized their interdependence. The citizen class was restive under these oppressive conditions, and needed only the successful example of some neighboring people to start the revolution within their own country.

There was in the Netherlands at this time at least one thoughtful man who foresaw the approaching social revolution and realized the danger which threatened his native land if unaccustomed rights and powers should become the possession of those who heretofore had felt the power of others. This man was Jan Nieuwenhuizen, the founder of the Society of General Welfare. It is impossible to estimate the good which has been accomplished by this organization. It instituted free schools, and gave to the state the scheme on which the present public-school system rests; it established savings banks, and the Postal Savings Bank—now the model of the world—was glad to copy after them; it conducts a sort of neighborhood loaning banks, and it is likely that its plans will be incorporated in the agricultural banks now under consideration. Through its instrumentality people of different classes are brought together in periodical meetings, when the lower can learn by observation from the higher, and lose much of the prejudice and envy which is so often felt, while the higher will become more tolerant toward the lower as they realize the burdens which the latter carry, and appreciate the obstacles which mar their progress, thus leveling many of the artificial class distinctions.

What this society has done for Holland, "Ons Huis" is trying to accomplish in Amsterdam; and though the latter is occupying a more limited field, its energies are more concentrated and its methods are such as to warrant its characterization as a practical charity.

The founder of "Our House," Mr. Janssen, fully realized that outright giving while blessing the giver is of questionable value to the recipient, and alms once accepted suggested in the ease with which it was obtained that a second be asked for, and the feeling of dependence soon calls into existence the belief that the uncontracted debt of a living must be collected. We therefore find a charitable organization in which everything must be purchased, but at cost so slight as to be within the reach o fall, yet being a charge, no benefit is esteemed for naught because it was obtained for nothing.

We find this unique society in a sort of "people's palace" in the very center of Amsterdam's working population. The building, which is the gift of Mr. Janssen, is on Rozen Street, Nos. 12, 14, and 16, extending through to Rozen Gracht, and contains a board room, reading room, library, gymnasium, lecture room, assembly rooms, large hall, kitchen, quarters for the janitor's family, and a restaurant.

The purpose is declared to be "to promote the moral and material development of the people—poor as well as rich—both in giving and receiving by inducing those who are blessed with knowledge or money to assist their fellow-beings whose lives are monotonous and devoid of comforts and pleasures." The very name—"Our House"—is intended to show that within its walls all enjoy equal rights, that the less learned are the younger members of the family whom the less ignorant will gladly instruct, and that the purposes and aims of all classes should be the same. Both sexes have equal privileges, and the religious and political views of those who attend the meetings or enjoy the benefits offered are never inquired into. The adherents of all faiths are treated with equal deference, and the only condition imposed is the observance of such principles of etiquette as should find favor in every home.

Since the day of rest of the various religious sects is not the same, all days are regarded as of equal importance, but, to meet the objections of the Protestant clergy that the exercises here kept people away from the church services, it has been decided not to open the building on Sundays until noon. But as the hours of employment of many persons are so long that their evenings are not free, the reading room is open on this day after the hour named, and certain instructive lectures are given during the afternoon. At these the average attendance is about five hundred. A strong effort was made to have the building closed during the whole of Sunday, however. The argument was made that as long as beer gardens and places of amusement were open on this day, the people should not be restricted on the only holiday of the week to those places where money is spent for trifling pleasures. The large number of persons who spend Sunday afternoon in the reading room proves that the opportunity to make good use of their time is fully appreciated.

Before giving in detail the plan of work in hand, it should be said that the director has secured the assistance of about one hundred and fifty men and women who are willing to contribute their time to the furthering of the purposes as outlined. They are divided into fourteen groups, or committees, each looking after a single interest. The means as at present constituted for attaining the ends in view may be classified as follows:

1. Reading room for men and women not under eighteen years of age; open daily.

2. Wednesday evening lectures on literature, history, physics, pedagogy, political economy, and travel. These lectures are open for debate.

3. Courses of lectures on different topics for men and women separately, or for both together. These discussions are marked by an intimate tone.

4. Sunday evening meetings: musical or theatrical performances, magic-lantern pictures, tableaux, etc. These are given in the large hall, which accommodates five hundred and twenty-five persons.

5. Legal advice.

6. Clubs for boys, girls, men, and women. Friendly intercourse. Discussions on scientific subjects. Chess club. Travel club.

7. Lessons in Dutch, French, English, and German, bookkeeping, reading and writing for adults, needlework, mending, making and cutting of one's own clothes, cooking, drilling for boys and girls, fencing, acting, chorus singing.

The reading room is provided with a large number of daily and weekly papers, magazines, and technical journals, together with such books as could be purchased or obtained as donations. The user of the reading room pays ten cents a quarter, with the privilege of bringing one friend a week as a guest. Every conceivable device is employed to induce visitors to make use of the books; for example, the lecturers frequently choose a literary topic, and refer to the books in the library, or one of the members of certain manual-training classes read aloud while the others work. Then some of the social evenings are given up to the discussion of a new or popular author, and persons skilled in reading aloud are asked to read or recite choice extracts. To accommodate those who feel that three months' subscription is for too long a period, the regular admission fee of two Dutch cents—equivalent to eight tenths of a cent of our money—gives the right to make use of the library during the visit. It now looks as though the impulse to secure a shortening of the work day would come from this organization in its desire to secure for its beneficiaries a longer time in which to profit by the use of the books and special opportunities for study here placed at the disposal of the workingmen. The reading room is looked after by a committee of twenty, some of whom are always present to give aid and advice to the readers, to answer such questions as may arise, and to keep the books and papers in place.

The lectures conducted in Our House are of a twofold character—individual discourses and a series of discussions of a given topic. Every Wednesday evening between November and April is provided with a speaker by the lecture committee, who treats in a popular manner a subject of his own choice, and allows the auditors at the close of his talk to ask questions regarding the topic in hand. The average number of persons attending these lectures last winter was about three hundred, and the charge for a single admission is two cents, with a considerable reduction when four or six tickets are purchased for one family. In the course lecture the most popular topic so far has been natural science, especially botany, physics, and chemistry. In this connection it is interesting to note that the luxuriant flora of the East Indies, with which the Dutch became acquainted long ago, gave an impetus in Holland to the study of botany. The people of all classes are fond of plants and flowers, and it is not surprising to learn that twenty persons followed a course of instruction in botany. A prominent physician of Amsterdam gave a course of ten lectures upon "The First Aid to the Injured," and eighty men and women profited by the practical discussion of this subject. The cost of these lectures is four cents apiece.

Somewhat related to the above are the concerts, Sunday evening meetings, and performances of various kinds which are given under the auspices of the appropriate committees. Perhaps one of the most profitable evenings of the winter is when manufacturers and employers are invited to meet those of the working class who may wish to be present to discuss in an informal manner questions of common interest. Under the genial leadership of Mr. Janssen and the director, much of the restraint usual on such occasions is thrown aside and the employer and employee sit side by side, and each listens to the undreamed opinions and experiences of the other. At one of these meetings the question of a shorter work day was discussed from the standpoint of the employer, the laborer, and the humanitarian. The investigations of our own Bureau of Labor were quoted to show the benefits resulting from a shortening of the day of work, and it is more than likely that the outcome of the discussion will be an intention on the part of the manufacturer to curtail the hours of work just as soon as possible, while the laborers, in learning of obstacles of which they were ignorant, will await more patiently the action desired.

The classes or individual pupils contribute their services to the committee in charge of entertainments. This committee sees to it that three Sunday evenings of each month are provided for, either from the ranks of home talent or with the aid of outside artists. In the concerts some of the best performers of the land have gladly taken part, and the music of the greatest composers has been heard here. As in all other cases, there is a charge for admission—four cents for one and six cents for man and wife. A feature here in vogue might well be copied. In arranging the selections for a concert the effort is made to always include at least one popular piece, or a song of national, artistic, or patriotic interest; then on the programme the words of this song are printed. The audience may be asked to join in the chorus, but even if this is not practical the people can catch the air, and with the words before them in later days they can make melody in their homes. If we recall the class of people for whom these provisions are made, and keep in mind the limited avenues of enjoyment open to them, we will appreciate the boon of such a considerate act.

It might be tedious to enumerate the various classes here conducted, and give even in brief an outline of the methods, experiences, and results. Each lesson costs from two to four cents, and the pupils—many of whom have reached middle life—show a commendable zeal in prosecuting their studies. However, two topics deserve mention—the lessons in mending and in cooking. Since it is the poorer people who are to be benefited by the work of Our House, lessons in economy are needed, if not demanded, and the earlier opportunities for acquiring these lessons have been meager. The authorities have therefore wisely decided to so instruct the housewives of these people that their clothing may look well even if mended and the family meals be palatable though simple. It is believed that the result of such teaching will make many homes more attractive, and keep the men from seeking outside of the house conditions which they should find within.

The clubs also serve as valuable adjuncts to the work in hand. They are usually groups of persons of the same sex and near the same age who meet under the guidance of some experienced man or woman for social intercourse, for practice in debate, playing of chess, the reading of some standard author, or the discussion of places and peoples. In all of these meetings, as well as under all circumstances, the people in attendance are taught polite behavior by example rather than precept, and every precaution is taken to avoid any reflection or invidious comparisons that might tend to keep away the people whom Our House is intended to benefit.

A word might be said about the travel club. Early in each autumn a proposition is made that during the following summer a trip will be taken to such and such places, usually naming one near by, within the kingdom, and another farther away, as Brussels or the upper Rhine. Persons desiring to visit either of the places named unite in forming a club. They meet at stated times to listen to accounts of the place selected, its historical associations, and the points of interest *en route*, and also to pay into the treasury an amount agreed upon. For example, last summer one club, upon the saving of a cent a week by each member, was able to go to Haarlem and spend the day in seeing the city and the many places of interest in the neighborhood. In another, each member contributed ten cents a week, and the club was able to make a two days' trip to Brussels. By this simple means persons otherwise unable to go beyond the confines of their native city have the opportunity to get at least a glimpse of the outside world, and under such conditions and with such special preparations as to obtain from the trip the maximum interest and profit.

The only thing that is free in Our House is legal advice and the writing of legal documents. In Amsterdam, as elsewhere, the poorer people have too frequently an exaggerated idea as to their rights, and rush into "law" for fatuous protection. Such persons are liable to fall into the hands of unprincipled lawyers who help to nurse the fancied wrong and encourage a suit for damages, or put up an idle defense for the sole purpose of winning a fee. To protect this class by giving them the most unselfish advice possible, a number of the best lawyers of the city have cheerfully offered their services, and every Thursday evening from eight to twelve o'clock one or two stand ready to give gratuitously the best advice they can upon such legal points as may be presented. That this service is appreciated may be seen in the fact that from ten to twenty persons profit by this privilege every evening. On this evening persons are present for the purpose of writing letters for those unable to write, and also to draw up legal documents for such as need them.

Mr. Adma van Scheltema—a name closely identified with every good work in Amsterdam—has organized in Our House art loan exhibits. For one half of the days during which the exhibit is open there is no charge for admission, while a slight fee is exacted on the other days. From these exhibitions much pleasure as well as instruction has been derived, and, located in a section which sends but few visitors to the art museums, one can realize that they perform a good work, as missionaries in cultivating the people's taste.

Such is, in short, an account of a practical charity—a charity, in truth, not because something is furnished for nothing, but that so much is given in return for so little. During the past year more than three thousand persons were registered as enjoyers of the privileges offered. Mr. Janssen gave the building and in one sense endowed the work; Mr. Tours gives his time, wisdom, and energy in directing its affairs; they both ask the wiser men and women of the city to give a few hours of each month or year. They have not asked in vain, and the cheerful responses give promise of the coming of the time when the only answer to the question, "Am I my brother's keeper?" will be an energetic "Yes."

SKETCH OF FRANK WIGGLESWORTH CLARKE.

THE great advance which chemical science has made in the United States during the past thirty years has been brought about by the joint operation of several factors, of which we may mention the formation and the influence of chemical societies seeking to further its development, the intelligent labors of individual investigators cultivating special fields, and the systematic pursuit of experimental work with reference to certain definite results. In this shaping of chemical research in such a way as to make it most efficient, the work and influence of Frank Wigglesworth Clarke have been prominent and important. His own labors have been industriously and unselfishly pursued with an eye to the advancement of the science, and their value has been generally recognized. It seems as if he had taken to himself a hint thrown out in one of his earlier scientific papers, and, giving up the transient glory of brilliant experiments, had devoted himself to setting the science as far forward as possible in single branches.

Professor Clarke was born in Boston, March 14, 1847, and was graduated from the Lawrence Scientific School of Harvard University in 1867. Two years later, in 1869, he was appointed instructor in chemistry in Cornell University, the first assistant ever appointed at that institution. His next position was that of professor of chemistry and physics in Howard University, Washington, in 1873 and 1874. In the latter year he became professor of chemistry and physics in the University of Cincinnati, in a position which he held till 1883, when he became chief chemist to the United States Geological Survey and honorary curator of minerals in the United States National Museum, where he still remains.

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Many of his popular articles relate to educational affairs, and present forcible arguments for a fuller recognition of science in the course of instruction, and cogent demonstrations of the need of better teaching of science and better qualified teachers. When occasion has arisen, he has fearlessly exposed and denounced humbug in education. In a paper on The Higher Education, published in the seventh volume of the Popular Science Monthly, having defined the purpose of true education as being "to develop the mind; to strengthen the thinking faculties in every possible direction; to render the acquisition of new knowledge easier and surer; to increase the student's resources; and to render him better fitted for dealing with the useful affairs of the world," he sets forth the advantages of science over the ancient and even the modern languages for the accomplishment of it. Science, he reasons, furnishes as good ciated may be seen in the fact that from ten to twenty persons profit by this privilege every evening. On this evening persons are present for the purpose of writing letters for those unable to write, and also to draw up legal documents for such as need them.

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Page 111, first line: For March 14, read March 9.
" " fourteenth line: For 1875-'76, read 1873-'74.
" " seventeenth line: For 1876, read 1874.
" " " " For Detroit, read Hartford.
" " twentieth line: For 1888, read 1878.
" " twenty-seventh line: For 1869, read 1868.

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Professor Clarke, having become a member of the American Association for the Advancement of Science in 1869, assisted, in 1875–'76, in the organization of its section on chemistry, a branch which had theretofore been but little represented in the Proceedings of the association. Prof. S. W. Johnson was elected chairman of the new section for the meeting in 1876 at Detroit, and Professor Clarke was commissioned to make the necessary efforts to insure a full attendance of chemists and others interested in the applications of chemistry. In 1888 he presided over the section; and he has ever been active in building it up, and in the development of the American Chemical Society.

Professor Clarke has published about seventy-five scientific papers in various journals, and many popular articles, especially in Appletons' Journal and the Popular Science Monthly. His first scientific paper, A New Process in Mineral Analysis, was published in the American Journal of Science for March, 1869. Other important papers have related to analytical methods, to the constitution of the tartrates of antimony, and to topics on chemical mineralogy, including especially the constitution of the silicates.

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By the multiplication of competing colleges putting sectarian interests in the foremost place, the means were divided up and frittered away, which, concentrated in one institution, would hardly be enough to enable it to do really effective work. "Each college acts as a drag on all the others. Libraries, cabinets, and faculties are uselessly duplicated. Naturally, one result of this state of affairs is a lowering of educational standards. . . . Since, on account of this foolish division of forces, most of these colleges are inadequately endowed, they are compelled to work short-handed. One professor has frequently several branches to teach. . . . In the majority of cases there is a chair of Latin, a chair of Greek, and then—a chair of 'Natural Science.' Each linguistic professor is to some degree a specialist; while the one who teaches science is perforce compelled to be a smatterer. He is expected to teach half a dozen dissimilar branches, each one being a life work by itself. He is to be omniscient on about a thousand dollars a year."

That the character of these institutions, as well as their poverty, was detrimental to the advancement of scientific education was more fully shown in another article on American Colleges *vs.* American Science, in the ninth volume of the Monthly. The colleges were described as being to a large extent denominational institutions, "equipped and endowed with due reference to the perpetuation of sound faith, and incidentally to the encouragement of what is supposed to be learning. . . . The very fact that a college has been established for theological purposes, or for ecclesiastical aggrandizement, is adverse to good scientific research. . . . Every year professors are chosen, not on account of scientific ability, but for reasons of a theological or sectarian character. If two men, one a Baptist and the other a Unitarian, were candidates for the same professorship in a Baptist university, the former, even if very much inferior to his rival, would almost certainly be elected. . . . Theological soundness in such an institution far outranks scientific ability. If Laplace had lived in America, no college would have tolerated him for an instant. Almost any decayed minister, seeking an asylum, would have beaten him in the race for a professorship."

These conditions were shown to have necessarily a bad effect upon American science, and to be not likely to arouse or encourage the scientific spirit. The student "becomes accustomed to regard the sciences as comparatively unimportant," and "graduates in complete ignorance both of the methods and of the aims of science, having learned only a few disconnected facts concerning the great world about him."

Improvement in these conditions, the author argued, must come partly from within and partly from without. The colleges must reform their ways, and, not being likely to do it spontaneously, must be hepled—by pressure of public sentiment and, later, of legislation. This suggestion proved to be introductory to that of a very important line of work, for the furtherance of which Professor Clarke seems never to have been able to labor too earnestly and industriously.

"But how," he says, "should public sentiment be properly shaped and made available for service? How is the natural, though slow, growth to be fostered and directed? Mainly by the efforts, organized and individual, of scientific men. Personally, every worker in science should strive to awaken in the community about him a comprehension of the value and purposes of his particular branch. In other words, the real investigators ought to do more toward popularizing their discoveries instead of leaving that task to amateurs or charlatans. At present, unfortunately, too many able scientific men depreciate popular work and hold aloof from it. They do nothing themselves to interest the public, and then lament the fact that the public does not become interested. Yet just here is where the beginning must be made. With a wider public interest in science will come deeper public appreciation, and this will develop the tendencies necessary for the improvement of our colleges and schools. Until the people see and recognize the difference between true investigators and mere collectors of specimens, between original workers and text-book authors, little real progress will be made."

While these pictures were correct, when made, of a very large number of American colleges, a vast improvement has taken place since the articles were written in the quality of instruction given; but there yet remain too many institutions to which they are still not inapplicable.

This was not the beginning of Professor Clarke's efforts to show men of science that the true interests of their cause lay in their making their knowledge easily accessible to the public. In the first volume of the Monthly he had an article on Scientific Dabblers, the purpose of which, as he defined it, was, after calling attention to the silly character of much that was called "popular science," to urge upon true scientific men the importance of rendering real knowledge more accessible to the masses. There is a demand for science, he said, "or the trash which is written would not be read. It works into nearly all departments of common life, and is, in one way or another, of interest to almost every one. Yet, as I have already said, the current popular lectures upon scientific topics are frothy and worthless; the theologian often misrepresents science for partisan purposes; and the newspapers, with all the good they may do, are too frequently conducted by those ignorant of all science. The people ask for knowledge, and unwittingly get much chaff with their wheat. . . . Therefore it seems to be time that true students of science should seek to popularize their learning. . . . Men of science constantly lament that the Government does not extend more aid to scientific research. The Government is a popular one, and the people must be trained before its help can be expected. Therefore it is for the interest of the teachers, as well as for the good of the people, that scientific truths should be popularly put forward in simple, untechnical language, and made accessible to all."

Later, in his chairman's address before the Chemical Subsection of the American Association, in 1878, he had this subject in mind, and mentioned it as part of the work of the section "to attract public attention to the subjects that interest us, and to do what we can to secure for chemistry a wider appreciation and greater means for development. . . . If the general public," he said later in his address, "is not interested in chemistry, it is because we as chemists have neglected a part of our duty. We have but to speak, in order to command the public ear."

Another side of scientific advancement to which Professor Clarke's working life has proved him much attached is presented in this address at the American Association meeting of 1878, and more minutely as to the particular point we have in mind in an article on Laboratory Endowment, in the tenth volume of the Popular Science Monthly. In the association address he insisted strongly upon the physical side of chemical research, stated briefly as the study of the phenomena which occur during the reactions in chemical experiments, or of the transformations of energy, and upon the importance of the co-ordination of studies separately pursued to the systematic and permanent advancement of the science; for which purpose he considered endowed laboratories for research extremely desirable. In such laboratories adequate corps of thorough specialists should co-operate in those investigations which individuals could not undertake; every worker should be assigned to definite, positive duties, the accurate and careful performance of which would eventually be sure to advance exact knowledge. The work would be hard routine, and the real value of the institution would be independent of everything sensational, and would rest upon considerations of the most severely practical kind. As an example of such work he mentioned the study of the connection between the composition of a substance and its physical properties. Supposing this taken up systematically by a well-organized body of investigators, the first step would be to determine, carefully and with the utmost rigor, the physical properties of the elements. Each one of these substances would have to be isolated in quantity and in a chemically pure condition, such as has never been attained as to some—a labor which would of itself involve a great amount of research. Then would come the measurement of physical relations, thermal, electrical, optical, magnetic, mechanical, and so on; and the determination of all their "constants" under widely varied conditions, notably of pressure and temperature; labors which would in many cases involve the comparative testing of various methods of research, and often the invention of new experimental processes. The number of elements and of their compounds which should be taken up in some regular order, series by series, would afford almost illimitable fields of research to large numbers of students; all of whom, if laboring under some plan of systematic co-operation, might contribute directly and efficiently to the perfection of the science. "One chemist might undertake to furnish certain of the elements in a perfectly pure condition; another might carefully determine under varying circumstances their densities and rates of expansion; a third could work up their latent and specific heats; a fourth their electrical relations, and so on. Failure to attain grand results would be impossible. Doubtless the labor would prove irksome and monotonous, but the reward would be sure. In five years, more would be done toward rendering chemistry an exact science than can be accomplished in a century by means of chemical investigations at present most in vogue." Chemists engaging in work of this kind would have to make sacrifices, for it would offer little promise of sensational reputations to be gained through dazzling discoveries, and would have to look to the ultimate glory of the science for their chief reward.

Professor Clarke has not omitted to practice what he thus preached; and while he has not failed to win honors in other fields of the science, has made it the chief work of his scientific life to advance toward solution one of the physical problems of chemistry indicated above. He has taken as his special field of research the "constants," and of these, the one which is perhaps the most fundamental of all, the revision of the atomic weights—not by experiments of his own so much as by comparison and criticism of the work of all who have undertaken the task, eliminating errors and finding from the sum of the whole what is the nearest deducible approach to accuracy. In 1872 he sent to the Smithsonian Institution a compilation entitled A Table of Specific Gravities, Boiling Points, and Melting Points for Solids and Liquids. This was accepted by Prof. Joseph Henry, who made it the first publication of a projected series to be called The Constants of Nature. To this series Professor Clarke has since contributed Tables of Specific Heats, of Expansions, and a Recalculation of the Atomic Weights. A new edition of the Specific Gravities was issued in 1886, and a second edition of the Atomic Weights in 1897. For the past five years Professor Clarke has contributed an annual report on atomic-weight determinations to the Journal of the American Chemical Society, giving each year a consistent table of values brought thoroughly down to date. These tables are now used in all parts of the world as standards for reference.

As chemist of the United States Geological Survey, Professor Clarke has published ten official bulletins of work done in the laboratory under his charge, of which Bulletin 125, The Constitution of the Silicates, and Bulletin 148, Analyses of Rocks and Analytical Methods, by F. W. Clarke and W. F. Hillebrand jointly, are the most important. Other works are: Weights, Measures, and Money of All Nations, 1875; The Elements of Chemistry, a school text-book, 1884; and a Report on the Teaching of Chemistry and Physics in the United States, published by the United States Bureau of Education in 1881.

A paper published by him in the Popular Science Monthly for

January, 1873 (Volume II), on Evolution and the Spectroscope, showed that the evolution of the planets from nebulæ was possibly accompanied by an evolution of the chemical elements. This was nearly a year in advance of Lockyer's first paper suggesting the same general view. The discussion of this subject was taken up again in the eighth volume of the Monthly (February, 1876), in an article, Are the Elements Elementary? in which the author, after showing how subtle connections significant of unity run through them all, inquired: "If the elements are all in essence one, how could their many forms originate save by a process of evolution upward? How could their numerous relations with each other, and their regular serial arrangements into groups, be better explained? In this, as in other problems, the hypothesis of evolution is the simplest, most natural, and best in accordance with facts. Toward it all the lines of argument presented in this article converge. Atomic weights, specific volumes, and spectra, all unite in telling the same story, that our many elements have been derived from simpler stock." These views were admitted to be speculative but not baseless. "Science is constantly reaching forward from the known to the unknown, partly by careful experiment and partly by the prophetic vision of thought." Then, speculation upon such questions "is not altogether unprofitable. The time spent in conjectures and surmises is not wholly wasted, for it is impossible to follow up any of the lines of thought thus opened without reaching some valuable suggestions which may pave the way to new discoveries. New truth, in one direction or another, is sure to be reached in the long run. So, then, we may proceed to theorize in the most barefaced manner without entirely quitting the legitimate domain of science." An article on The Present Status of Mineralogy, in the thirty-second volume of the Monthly, presents the mutual bearings of that study and chemistry and geology.

Professor Clarke contributed the chapter Element to the last edition of Watts's Dictionary of Chemistry. He was made president of the Washington Chemical Society in 1885, and of the Philosophical Society of Washington in 1896. He organized and had charge of Government exhibits, on behalf of the Department of the Interior, at the expositions of Cincinnati, Chicago, Atlanta, Nashville, and Omaha. He is a corresponding member of the British Association, of the Edinburgh Geological Society, and of the New York Academy of Sciences.

Correspondence.

THE MOON AND THE WEATHER.

Editor Popular Science Monthly:

Dear Sir: Scientific investigators in meteorology have again and again declared they have not been able to discover by accurate and long-continued observation that the moon has any effect whatever upon terrestrial weather; yet the farmers have, for unreckoned years, undoubtingly ascribed certain kinds of weather—changes, especially—to the moon; and, despite the dictum of the scientists, they have persisted in their confidence in the pale orb as a weather-breeder, and as a disposer, in a large degree, of the wet and dry features of the months.

Now comes Mr. H. H. Clayton, meteorologist at the Blue Hill Meteorological Observatory, and shows by diagram and dates that the *electrical* condition of the atmosphere varies in close accord with the position of the moon in her orbit.

That electricity performs various offices in the atmosphere, notably among the particles of vapor, is well known; but just how and to what extent atmospheric phenomena result from electrical action has not yet been clearly demonstrated. However, we have now a scientific basis for the assumption that the moon has an influence on the weather.

An interesting summary of present knowledge concerning the atmosphere is contained in Studies of the Upper Atmosphere, by A. Lawrence Rotch, director of the Blue Hill institution. The diagram of comparative altitudes, which forms the last illustration of my article on kite-flying, in the May number of this magazine, is from the frontispiece of Mr. Rotch's pamphlet just mentioned, for which credit was inadvertently omitted.

George J. Varney.

57 Cornhill, Boston, *August 19, 1898.*

Editor's Table.

THE GOAL IN EDUCATION.

MANY of our readers, we are sure, must have been impressed by the articles on The Philosophy of Manual Training lately contributed by Professor Henderson to the pages of this magazine. The thought underlying them is one to which we have ourselves often endeavored to give expression, namely, that the end of education is wholly misconceived unless we consider it as aiming to bring the individual into right relations, at as many points as possible, with the world in which he lives, and to place him in as full possession as possible of the varied powers and capacities of his nature. It is because he regards manual training as the most effective instrument for awakening the intellect in the first place, and then for establishing a proper balance between the mental and bodily activities, that Professor Henderson has advocated it with so much earnestness. All that he has said on the subject seems to us deserving of the closest attention.

In the old system of education language was regarded as the supreme and sufficient instrument of mental development; and in the great public schools of England this idea enjoyed the very highest degree of prestige and authority. By language in these establishments, the two classical languages of Greek and Latin were meant, the English language receiving very scant attention, and English literature none. If any one was so far in advance of the times as to express a doubt whether a knowledge of Greek and Latin was the only preparation needed for life, he was pointed to the brilliant men who had come from the forms and the playgrounds of Eton and Winchester and Harrow; and the discussion was considered closed. The fact is that the radical insufficiency of the system was masked to a great extent by the circumstance that it was mainly applied to a ruling class, who early in life obtained a more practical training in public affairs. Pitt was educated, as has been remarked, by that great statesman, his father, the Earl of Chatham, and Peel by a great manufacturer who took a keen interest in politics. Robert Walpole, leaving the university at an early age, had the society of his father, a most practical-minded country squire, whose original ambition had been to make him the greatest grazier in the kingdom. Many similar cases could be cited in which early introduction to society and to practical life made up for the deficiencies of scholastic training, and reflected, or seemed to reflect, on that training a much greater credit than it deserved.

It may be admitted, however, that as a preparation for a political or forensic career an old-fashioned classical education was not wholly without efficacy. It was systematic and orderly; it was rigid in its requirements; it presented difficulties which had to be overcome, and afforded the means for unmasking looseness and inaccuracy of thought; finally, it called into constant activity, though in a narrow field, the discriminative and analytical faculties. Its weakness lay in this, that it did not reveal the nature of things, but promoted a dangerous habit of "moving about in worlds not realized," and of giving to words an importance which should only be conceded to verified and comprehended facts.

Nowadays we mix, or try to mix, a modicum of scientific knowledge with the education we impart. This is so far good. It affords a training in observation and verification, and opens up to the young sources of interest of which they may increasingly avail themselves in later years. Moreover, as the scientific instruction generally embraces more or less of physiology and hygiene, it places them on their guard against the formation of injurious habits, and shows them the conditions on which health depends. These are advantages which, so far as they go, it is impossible to appreciate too highly.

It takes more, however, than the admixture of a little physical science in a school curriculum to make, in a wide sense, the education that is required for life. What is further required is a proper adjustment of the mind toward life with its varied activities and its infinite possibilities of good and evil. When we see men of fine literary gifts growing more cynical as they advance in years, and treating the world to stronger and stronger doses of pessimism in their writings, we are compelled to believe that their adjustment to life must have been wrong. When we see men of science who year by year appear to have less and less in common with their fellow-creatures, and whose studies only develop on the intellectual side an ever-increasing passion for the infinitely minute and the vastly unimportant, and, on the moral, a morbid sensitiveness to all kinds of personal questions, we find it difficult to think that they were properly oriented at the start. It may not be given to every one to "see life steadily and see it whole"; but it ought to be possible for a well-trained mind to see it with an eye of calm, tolerant, and sympathetic contemplation. No education is complete which leaves out such knowledge of the world, and of the relation which the individual sustains to it, as shall at least tend to give a right purpose and direction to the individual life. "The world is very evil," is a pious utterance; but it is equally pious for each of us to ask how much of evil is lurking in ourselves. We conceive of a scientific education in the full sense as one which, while it imparts true ideas in regard to the physical history of the globe and the chemical elements that compose it, aims no less at unfolding the true constitution of society, the springs of human action, the strength and weakness of human character, the possibilities of good and evil that reside in every individual, the misery that waits on wrongdoing, and the happiness that flows from just and pure deeds. There is a way, we are persuaded, of presenting the world of humanity to the minds of the young which would tend to create in most—in the vast majority—a strong desire to take a helpful part in the work of their age and generation, and not to concentrate all their efforts on the business of self-advancement. It is merely a question of seeing the facts in a broadly human, which is after all the only true, light.

Let us have in education literature and analytical studies and science with its grand constructions and sanifying discipline—all the useful elements—but let the true goal of education be kept ever in view, which is, not to enable this individual or that to shoot to a preeminence over his fellows, but to place the individual in right relations with his fellows, to give to each a career of useful activity, and to prevent that dreary disappointment with life and all its works which overtakes so many in their declining years. Life has its burdens, but it is not vanity; and the normal action of human beings on one another should be to give to each separate existence a higher value and deeper sources of happiness.

A DOUBTFUL APPENDIX TO SCIENCE.

It was perhaps to be expected that Sir William Crookes, as president of the British Association, would, whatever else he touched upon in his presidential address, say something in regard to the special views which have now for many years been associated with his name. In point of fact he did do so. Beginning with a survey of the world's resources in the matter of wheat production, and an inquiry as to how the fertility of the soil may in future be kept up, he passed to the constitution of matter and molecular action as illustrated by the phenomena of Röntgen rays, and finally referred to "experiments tending to show that, outside our scientific knowledge, there exists a force exercised by intelligence differing from the ordinary intelligence common to mortals." These experiments were made, we are told, more than thirty years ago. It does not appear that any substantial or indubitable addition has been made to the evidence which these experiments afforded, or were supposed to afford; but Professor Crookes "thinks" he can "see a little further now." "I have glimpses," he says, "of something like coherence among the strange, elusive phenomena." That undoubtedly is a good thing to get glimpses of; but there is perhaps room for question whether the extreme interest of the professor in the "strange elusive phenomena" has not led him to make a little more of the "glimpses" than strict scientific method would warrant.

It is really only necessary to read the concluding portion of Professor Crookes's address to see that he is dealing not with science but with crude imaginations. He says that "confirmation of telepathic phenomena is afforded by many converging experiments," but especially by "the subconscious workings of the mind when these are brought into conscious survey." There is really no meaning in this. How can any "survey" be other than conscious? And what is there in the subconscious workings of the mind adapted to prove that impressions can be made upon the mind otherwise than through the recognized channels of sense? "The patient experimentation of the Society for Psychical Research is probing subliminal processes and learning lessons of alternating personalities and abnormal states." There is no objection in the world to all that; but it would take more than an alternating personality or an abnormal state to enable a mind to gather knowledge from another mind without the intermediation of intelligible signs. A sick man may act in a very singular way, but his sickness does not enable him to transcend the ordinary powers of humanity.

The eminent professor speaks of the cures wrought by suggestion (hypnotism); but seeing that the suggestions are made by intelligible signs, verbal or other, we find no support here for the telepathic hypothesis. We really gather from the professor's remarks that while a great many persons—some of high intelligence and of recognized position in the scientific or philosophical world—have been pottering away at this matter of telepathy and other phases of spiritualism for a great many years, things are to all intents and purposes just as they were before all these laborious researches began. This is not just the way the professor puts it; his words are: "A formidable range of phenomena must be scientifically sifted before we effectually grasp a faculty so strange, so bewildering, and for ages so inscrutable as the direct action of mind on mind." Sometimes the reason why a thing is inscrutable is because it isn't so; and that, we suspect, is the explanation in the present case. One hypothesis which the professor puts forward is simple to the last degree. It is that the molecular action of the brain, when thoughts are passing through it, is taken up by the ether and communicated to another brain in which it awakens similar thoughts. But the question we ask at once is why this wireless telegraphy between brain and brain is not going on all the time, and why we are all not driven crazy by the everlasting intrusion of other people's thoughts? If this is the process, why should neighboring brains be skipped, and the effect be produced upon one particular brain hundreds, perhaps thousands, of miles away?

"It is henceforth open to science," says Sir William Crookes, "to transcend all we now think we know of matter, and to gain glimpses of a profounder scheme of cosmic law." We really do not know when it was *not* open to science to do this *if it could;* and we do not see that the telepathists and other denominations of spiritualists have in any appreciable manner improved the situation as regards the probability of the thing being done. They have contributed floods of talk and tons upon tons of printed matter, and have worked thousands of people into variously grewsome conditions of mind; but if any one can point to a single distinct advance in scientific theory due to their peculiar methods, we can only say that we do not know what it is. Professor Crookes has been one of the foremost scientific workers of his day; and we find it hard to believe that he can be under any illusion as to the futility of the efforts of the spiritualist school. At the same time he is entitled to the utmost freedom of thought and utterance; and if he believes there is still hope of important gains to humanity from the side of spiritualism, he is justified in holding his position; and while we may think he is sadly misled, we must accord him the respect due to eminent talents and unquestioned sincerity.

THE CAUSE OF SPAIN'S DECADENCE.

UNTIL account is taken of the effect of war on the thoughts, feelings, and institutions of men, no headway can be made toward a rational explanation of the decadence of Spain. Since the outbreak of hostilities with that country, which has made the topic a favorite one with newspaper and magazine writers, every other explanation has been vouchsafed; but all of them, including the favorite one about the mental and industrial paralysis produced by the Spanish Inquisition, mistake effects for causes. Not one of them, so far as we have seen, has touched the root of the matter and pointed out that Spain has simply gone the way of every other nation that has devoted itself, not to the pursuits of peace, but to the destruction of life and property.

Like all other despotisms, Spanish despotism has been the inevitable product of the necessities of war. Success in that pursuit requires that the subjects of a monarch shall place unreservedly their lives and property at his disposal. He must be permitted to levy conscriptions without let or hindrance, and to impose taxes with the same freedom. The longer and more intense the militant activities, the more unmitigated the despotism. In Spain the conditions for the uninterrupted growth of such irresponsible power have been especially favorable. There were first the long wars with the Moors, then the Italian wars, the wars of the Reformation, the wars of the Spanish Succession, the Napoleonic wars, followed by a period of chronic revolution, and the wars carried on against the natives and other adversaries in the New World. The impulse toward a concentration of power in the hands of one man engendered by these incessant conflicts could not fail to blot out of existence every sentiment and institution of freedom. Only during the past twenty-five years of peace has either been able to gain a foothold and to give a promise of regeneration.

But the despotism growing out of war means more than the bare statement that all power over life and property has been placed in the hands of a monarch. It means that his subjects have been deprived of the right to think and act for themselves. He has taken charge of both their consciences and their conduct. In Spain, for some reason not easy to discover, the ecclesiastical despotism that accompanies the growth of political despotism became more potent and deadly than in the other countries of Europe. There the priests were more powerful sometimes than the monarch himself. With the institution of the Inquisition during the reign of Ferdinand and Isabella they wrought a havoc to the Spanish intellect that has no parallel outside of the great Oriental despotisms. To them is due the mental torpor of the Spaniards, who, according to U. J. Burke, wrapped themselves in a cloak and "sought safety in dignified silence." How could the spectacle of an *auto-da-fé* do otherwise than disincline a prudent man to think for himself and to tell what he thought?

That devotion to military pursuits inspires a contempt for industrial pursuits and gives birth to a feeling of superiority over the people engaged in them we see to-day in France and Germany. In those countries it has come to such a pass that civilians are regarded as almost without rights, since an officer imagining himself insulted may run them through with his sword, and as having no other function in the economy of the world but to work for their masters. In Spain during the years of her greatest military activity these feelings of a barbarian reached an intensity that can not now be realized. The only occupation outside of killing and plundering enemies either in Europe or America that a gentleman could follow was a career as a churchman or as an official in the home or colonial administration. "Public offices," says Henry C. Lea, describing the results of this absurd belief, "were multiplied recklessly, and the steady increase in the ranks of the clergy, regular and secular, was a constant subject of remonstrance. In 1626 Navarette tells us that there were thirty-two universities and more than four thousand grammar schools crowded with sons of artisans and peasants striving to fit themselves for public office or holy orders. Most of them failed in this through inaptitude, and drifted into the swarms of tramps and beggars who were a standing curse to the community." Hence the abnormal proportions of the ecclesiastical and bureaucratic establishments; hence also the almost total failure to develop the great natural resources of the country; hence, finally, the unprosperous condition of the industries not crushed out of existence by the regulations of the official parasites.

To many people the callousness of Spaniards to suffering and their disregard of the rights of others have seemed the greatest mystery. Why is it that they still cling so tenaciously to the pleasures of the bull ring? Why was it that they appeared so indifferent to the miseries of the Cuban reconcentrados? In the light of the influence of war on the sympathies these questions present no difficulty. Clear also does it become why the Spaniards possess as little patriotism as the Chinese. Training for centuries in the belief that the most honorable occupation is the killing and plundering of enemies or the filling of positions in church and state that obviate the necessity of earning a livelihood by honest toil is not fitted to inspire a keen sense of justice or a lively fellow-feeling. When people have been plundered for centuries by a greedy bureaucratic despotism they can not persuade themselves that it is their duty to protect their oppressors from foreign or domestic assailants. What they are most interested in is an opportunity to get a living. Whether the honor of their country is at stake, or whether there is threatened the loss of the last remnant of a colonial empire that has cost them blood and treasure beyond estimate, they are certain to be as indifferent as the victims of a slave driver to the misfortunes that have overtaken him.

Some friends of Spain have been inclined to regard the loss of these colonies as the culmination of her misfortunes. We can not but regard it as the beginning of better days. Although Spain has not been engaged in war on an extensive scale for a long time, her efforts to retain the control of a people anxious to be delivered from her incapacity and despotism have tended to keep alive the barbarous feelings and traditions of the past. The Cubans and Porto Ricans were not governed for their own benefit like the colonists of

Great Britain, but for the benefit of rapacious politicians and traders and manufacturers in Spain. In the colonial administration the former sought easy employment and speedy fortune. In the colonial commercial regulations the latter found an artificial support for trade and manufactures that could not have survived without them. By discriminations, Spanish millers, for instance, were able to import wheat, turn it into flour, and sell it to the colonists at a price scandalously in excess of that charged for the American product. Sometimes the trouble to grind the wheat was not taken. After it had been imported into Spain it was shipped to the colonies, and upon them was thrown the expense of needless transportation and the profits of superfluous middlemen.

With the complete extinction of the colonial empire of Spain will come to an end these opportunities for the pillage of industrious peoples. The parasites, commercial and bureaucratic, that have depended upon them for a livelihood will be obliged to turn their attention to more legitimate employment. There will be brought to an end also the immense sacrifice of life and treasure required to suppress the ever-recurring insurrections. Both will be left in Spain to develop her resources and to add to her wealth and prosperity; but, best of all, will cease the encouragement to the militant and bureaucratic spirit that the possession of the colonies fostered. The sentiments as well as the employments appropriate to peace will receive an impulse that ought to enable Spain to fill an honorable if not a glorious place in the future history of Europe. But this bright outlook is based upon the assumption that she will not join in the mad competition of her neighbors in armaments and thus fall a prey with them to the economic and moral ravages of "an armed peace."

DREAM AND REALITY.

An ingenious article by M. Camille Mélinand, which appeared a few months ago in the *Revue des Deux Mondes* under the title of Le Rêve et la Réalité (Dream and Reality), is reproduced, in its more important points, in translation, in the present number of the Monthly, and will repay perusal for the novel views it presents. The object of the writer is to show that there is not so much difference as is commonly supposed between the waking and sleeping states, that our dreams are not so illusory nor our waking experiences so absolutely real as we are in the habit of assuming, and that, as we wake from dreams, so we may expect to wake from what we call life into a condition of existence that will give us a new standpoint, and reduce all the experiences which we now take so seriously and tragically to the level of a dream. The only substantial differences he recognizes between our waking state and the dream state are (1) that in our waking moments we know that there is another condition which we call dreaming, while in our dreams we do not recognize a separate waking state; and (2) that, while we wake from our dreams, we do not wake from what we call reality.

M. Mélinand writes in a candid spirit, and yet we think his article is calculated to encourage a somewhat unhealthy type of mysticism. We do not see how it is possible to take too serious a view of the life we live in the present. Whether we view it tragically or not must depend in large measure upon our individual experiences; and happy are they into whose lives tragedy does not enter. The very fact that M. Mélinand would dissuade us from taking life tragically shows that he recognizes that life—our waking life—can be brought under the rule of right reason. He does not advise us not to take our dreams tragically, for he knows that the dream state is one not susceptible of rational regulation, and this, we think, might very properly be accounted a third very important difference between dream and reality. The true advice to give to those whose happiness we have at heart is, not to look upon life as a kind of dream, but to take it serious ly, to study its laws, and to accept the burdens and duties it imposes. It may be remarked that dreams give very little trouble, as a rule, to those whose waking hours are well spent, and whose minds and bodies are kept in a condition of healthful balance. We can indeed in the waking state take measures to reduce our dreams to a minimum, and to provide that at least they shall not be of a distressing character. Such being the case, it seems idle, to say the least, to speculate, as many besides M. Mélinand have done, on the possible reality of dreams. What Bottom said of his dream, "Man is but an ass if he go about to expound this dream," might be applied without much risk of error to dreams generally; unless the exposition takes the direction of endeavoring to explain what antecedent mental or physical condition, or what circumstances acting upon the sleeper, may have given rise to the dream in a given case.

M. Mélinand makes a remark, which the experience of many will confirm, that dreams sometimes throw a light of extraordinary intensity on characters and situations, giving us, perhaps, truer views of certain things than we had ever attained in our waking hours. This, however, would only imply the withdrawal at such moments of influences or conditions which, in our waking life, may have the effect of rendering insight less keen and uncompromising. If, for example, we could in our dreams revert to the standpoint of childhood, we should see many things with a directness which is more or less lacking to our mature cogitations, and pronounce judgments in a correspondingly down-right manner, with perhaps a closer approximation to absolute truth. This, however, would manifestly not imply any extension of our mental range, nor afford any guarantee of the "reality" of the dream life. The intuitions of the novelist or dramatist, when they are true and profound, give a wonderful air of reality to the scenes which the author portrays, but do not make them real. There are various waking states in which our perceptions are more than normally acute; and, as we know, the loss of one physical organ leads frequently to an increase of power in others; but these facts throw little light on the main problem of life, which is how to develop and use our normal powers to the best purpose and with the best results. At the same time it is well not to despise any knowledge that may come to us from dreams in the way of self-revelation or otherwise, but to use it for the strengthening of what is weak and the rectifying of what is wrong. In that way dreams may be made subsidiary to the better government of our higher waking life.

As to the conclusion the writer draws, that, as we wake from dreams, so we may some day wake from this life, which is so like a dream, we leave it to the judgment of our readers, merely remarking that it would be very unfortunate if the thought of such an awakening should lead any one to think little of this life, or abate any effort which he can make to render it, if a dream, a happy dream to himself and others.

Scientific Literature.

SPECIAL BOOKS.

THE period since the Congress of Vienna has been immensely fruitful of great and far-reaching events—of events that have essentially modified the fortunes of the world, its theories of government, and the condition of its peoples; and of that period the nearly fifty years covered by the second volume of Professor Andrews's history * have been most eventful and marked by momentous changes. At the opening of this history the continental sovereigns had established despotism throughout their domains on what they thought were firm foundations, and surrounded it with guards which they considered unassailable. The close of it finds the conditions reversed; government in the interests of the people recognized, and yielded to, even if grudgingly, by those backward monarchs who would prefer to contend against it. The first volume of Professor Andrews's history brings the story down to the close of the revolutionary movements of 1848, when the princes, again set upon their thrones, were studying and plotting as to how they might resume their old authority. In France, Louis Napoleon had become a central figure, and the tendencies were taking shape under which the republic was destroyed and imperialism established. Taking up the record again at this point, Mr. Andrews tells us he has treated only those phases of the history that concern the development of Europe in the larger sense, rather than that of each particular state or country. On the ground that no event can be understood in isolation, and that history is something more than a series of events chronologically considered, he has endeavored to give logical form to the treatment of the subject, to carry each movement forward to its conclusion before turning to the others; and has introduced nothing that did not seem to him to be absolutely essential to an understanding of the subject. He has not deemed it necessary to describe battles and military movements at length, and has omitted, with a few exceptions, biographical discussions. He has been successful in adhering to his plan, and, writing always dispassionately, yet without sacrificing interest, and with his mind fixed on the main object, has given a clear and complete view of what each event recorded signified and of what Europe has accomplished in the past half century. The first chapter concerns France, the failure of the second republic, and the rise of Napoleon III to imperial power. This was extremely unwelcome to the other sovereigns, who were disposed to resent the entrance of an intruder into their ranks, and led to diplomatic skirmishing, ending in the Crimean War—a war that "did not create the forces that led to the national unity of Italy and Germany, . . . but gave to Cavour and Bismarck the opportunity that each was seeking." It requires but a few uncolored words at the beginning of the story of the achievement of the unity of Italy—the mightiest event of the whole series—to picture Victor Emanuel the hero that he was. With similar success are presented the masterly statesmanship of D'Azeglio and Cavour and the high-souled patriotism of the people of Italy. This achievement, a victory

* The Historical Development of Modern Europe from the Congress of Vienna to the Present Time. By Charles M. Andrews. Vol. II, 1850–1897. New York: G. P. Putnam's Sons. Pp. 467. Price, $2.50.

over opposing Europe, compelled the recognition of an international principle based on the affinities of peoples, and inaugurated, "not only a new *régime* for Italy, but also a new public law for Europe." The empire of Napoleon, which rose to its culmination while these things were going on, was "nothing but an adventure out of accord with modern highly developed civilization," exhausted France and checked the education of the people in matters of government and habits of self-reliance. The rise of Prussia and the establishment, under Bismarck, of the unity of Germany, are regarded as an instance of the accomplishment of a noble end by the use of force. The struggle culminated in the war of 1870, the ultimate consequence of which was that "scarcely a vestige remained of those conditions of the Congress of Vienna which for so many years had been the anxious care of the European concert." The arrangement between Austria and Hungary, creating a dual monarchy, "established a government which was the result, not merely of political ingenuity, but of experience, and one that on the whole was successful"; and Austria has taken its place among the enlightened governments of Europe. The "Eastern question" is presented as one in which the attitude of the powers is no longer determined in Europe, but in China, India, and Africa, the settlement of which seems to be indefinitely postponed. The concluding chapters relate to present conditions.

Mr. *Seward* excuses himself in rather an apologetic way for undertaking to write a book on *Fossil Plants** for the Cambridge Natural Science Manuals—a task which Professor Williamson, a founder of modern palæobotany, had considered too serious; but students of botany and geology have cause to thank him for having consented to attempt the writing of a book intended to render more accessible some of the important facts of the science, and to suggest lines of investigation in it. The botanist and geologist, not being always acquainted with each other's subjects in a sufficient degree to appreciate the significance of palæobotany in its several points of contact with geology and recent botany, the subject does not readily lend itself to adequate treatment in a work intended for students of both classes, and the author has accordingly tried to shape his treatment with this point in view, and so as to adapt it to both non-geological and non-botanical students. As a possible aid to those undertaking research in this field he has given more references than usually seem appropriate in an introductory treatise—often to specimens of coal-measure plants in the Williamson cabinet of microscopic sections, now in the British Museum—and has dealt with certain questions in greater detail than an elementary treatment of the subject requires. His plan has been to treat certain selected types with some detail, and to refer briefly to such others as should be studied by any one desiring to pursue the subject more thoroughly, rather than to cover a wide range or to attempt to make the list of types complete. The book opens with a sketch of the history of palæobotany, which is followed by a discussion of the relation of palæobotany to botany and geology. A succinct review of geological history is then given, in which the several principal formations are briefly described. The theory of the pro-

* Fossil Plants. For Students of Botany and Geology. By A. C. Seward. With Illustrations. Cambridge, England: The University Press. New York: The Macmillan Company. Pp. 452. Price, $3.

cess of the preservation of plants as fossils is explained, the difficulties and sources of error in the determination of fossil plants are pointed out, and the rules for nomenclature and of priority in it are explained. The systematic part follows these introductory chapters, giving as full descriptions as the condition of the fossils admit, with illustrations—one hundred and eleven in all—of those belonging to the orders *Thallophyta*, *Bryophyta*, and *Pterodophyta*, carrying the subject as far as the *Sphenophyllales*. Technical as the subject necessarily is, the treatment is clear and, where the matter admits, fluent, so that no student need complain of difficulties in that line.

GENERAL NOTICES.

Dr. *W. Detmer's Practical Plant Physiology* * is a book of experiments for the use of teachers as well as of students in higher-grade schools, and supplies an aid to the study of the whole of that branch of the science by experimental processes. While the arrangement of the material in the second German edition is essentially the same as in the first, nearly every section has been enlarged or remodeled, and the book is essentially a new one; new experiments have been included for lecture demonstration or private work, and pains have been taken to render the book increasingly useful to serious students of plant physiology, especially to those who desire to familiarize themselves with methods of research. Great care has been taken in the selection of research material recommended for the experiments; and material suitable for winter work has received attention as well as summer material. This second German edition is presented by the publishers in the translation in its entirety, without addition or alteration. The two great divisions of the book are into the Physiology of Nutrition and the Physiology of Growth and Movements resulting from Irritability. In the first division the experiments bear upon the food of plants (assimilation, production of proteids, constituents of the ash, and organic compounds as food for plants); the molecular forces and processes (including movements of gases, absorption and movements of water, and absorption of mineral substances in plants); and metabolic processes in the plant. In the second division the characteristics of growing plant structures, the conditions necessary for growth, the influence of internal causes and external conditions; geotropic, heliotropic, and hydrotropic mutations, and other phenomena of irritability; the winding of tendrils and twining plants; dorsi-centrality, polarity, and anisotropy and phenomena of correlation; and movements of variation, are presented.

* Practical Plant Physiology. An Introduction to Original Research for Students and Teachers of Natural Science, Medicine, Agriculture, and Forestry. By Dr. W. Detmer. Translated from the second German edition by S. A. Moor. London: Swan, Sonnenschein & Co. New York: The Macmillan Company. Pp. 555. Price, $3.

The primary objects of Mr. *Hoffman's The Sphere of Science* * are to point out what constitutes a science, and set forth the ground upon which every science rests and the principles and rules that must be followed in order to construct one. The author maintains throughout that every department of knowledge is capable of scientific treatment, and must be so treated before any great advance can be made toward a consistent and rational conception of the universe. The subjects are considered in succession of the true conception and aims of science, what it takes for granted, the scientific method, certainty and probability in science, the use of the imagination, analogy as an aid, the limitations of science, recent advances in the physical sciences, the old and new psychology, modern scientific ethics, philosophy as the science of the sciences, and the harmony of the sciences. The author holds that the chief need in all departments of thought is not so much mere facts as a new arrangement and classification of facts already at hand; that we can

* The Sphere of Science. By Frank Sargent Hoffman, Ph. D. New York: G. P. Putnam's Sons. Pp. 268. Price, $1.50.

be certain of no doctrine, but the most we can do to establish it is to show that the balance of probabilities is in favor of it; that philosophy is the life of science and science the vital breath of philosophy, and if one is severed from the other both pine away and die; and that those scientific researches are successful which are not exclusively special, but are illuminated by an ample idea of science. The book is the outcome of a series of lectures given to classes in Union College to supplement their work in formal logic.

The *Text-Book of Geodetic Astronomy* * was prepared by Mr. *John F. Hayford* to meet the conditions of the course at Cornell University, the terms of which the standard works now in use could not be made to fit. The purpose of the book is to furnish a text short and easy enough to be mastered by the student of civil engineering in a single college term which shall give him a sufficiently exact and extensive knowledge of geodetic astronomy to serve as a basis for practice in that line after graduation. While it is primarily a manual for students, the author has endeavored to insert such matter, tables, and convenient formulas as would make it of value also to the engineer making astronomical observations. Mathematical processes have been omitted, except those that are actually necessary for developing the working formulas, and simple and special means for deriving the formulas have been chosen in every case admitting choice. Considerable attention has been devoted to a discussion of the various sources of error in each kind of observations. Those formulas have been selected, so far as possible, that lead to accurate and rapid computation.

L'Année Psychologique † of M. *Alfred Binet* and his colaborers in the Laboratory of Physiological Psychology of the Sorbonne, Paris, is now in its fourth year, and the four volumes present a compendium of the psychological studies and literature of the period they cover, the value of which will be appreciated by any one who has occasion to examine the work. The first volume was a book of 619 pages, with 33 figures; the second, of 1010 pages, 141 figures, and several plates; the third, of 825 pages, 103 figures, and numerous plates; and the present volume has 849 pages and 117 figures. The plan of all the volumes is the same; it is to present in full the labors of the laboratory, with original memoirs, and to give a condensed but adequate and classified summary of the world's literature of the year relating to the subject. The present volume contains twenty-seven original memoirs, mostly by Professor Binet and M. N. Vaschide, with others by M. B. Bourdon and Mr. A. Le Clère; about ninety reviews of books and papers, classified under sixteen heads, according as they relate to the physiology of the nervous system, the several senses, mental faculties and operations, movements, individual psychology and character, sleep, dreams, and pathological cases, and animal psychology; a bibliography, also classified, of 123 pages; and an index of authors, occupying 17 double-columned pages.

Prof. Cyrus Thomas has given, in his *Introduction to the Study of North American Archæology*,* a brief summary of the progress in the investigation and study of the subject which has been made up to the present time. The increased activity among students, the numerous explorations made, the accumulation of data and the flood of light thrown on questions relating to prehistoric North America since the publication of the last general work on it seemed to call for such a summary. While the author's chief object is to present and arrange the data so as to afford the student some means of bringing into harmony and utilizing the facts and materials at hand, yet, in view of the impossibility of presenting a full account of the archæological remains of the continent, and discussing all the questions connected with them in a single small volume, only those considered the best representatives of the

* A Text-Book of Geodetic Astronomy. By John F. Hayford. New York: John Wiley & Sons. Pp. 351, with plates.

† L'Année Psychologique. Edited by Alfred Binet—with the Collaboration of H. Beaunis, Th. Ribot and Bourdon, Courtier, Farrand, Flournoy, Philippe, Vaschide, and Warren. Editorial secretary, Victor Henri. Fourth year. Paris: Librairie C. Reinwald. Schleicher Brothers, publishers. Pp 849. Price, 15 francs.

* Introduction to the Study of North American Archæology. By Prof. Cyrus Thomas. Cincinnati: The Robert Clarke Company. Pp. 391.

leading types and those which best illustrate the arts, customs, and culture status of the former inhabitants are referred to. The movements and remains are treated under the three heads of the Arctic, Atlantic, and Pacific divisions; the first including the works of the Eskimos, the second those of the mound builders, and the third the curious variety of works scattered along the Pacific coast, and in Mexico and Central America, rising to great elaboration in the latter countries. Theories have to be considered, though they are all still uncertain, and Professor Thomas notices the various views which have been expressed as to the origin of the works and the people who executed them. He himself believes that they are all the work of the peoples who lived here when America was discovered, and are represented by the present Indians; that they are not of a very extreme antiquity; and that the continent was peopled by tribes who came down from the northwest through the region between Hudson Bay and the Rocky Mountains.

Of Nature books encouraging the study of the life around us we have an abundance —of some sorts, perhaps, a superfluity—and they have their uses, one of the chief of which is drawing people, who might otherwise never think of it, to the observation of natural facts, and to inquiry into their character and causes. Such books are fittingly complemented by the *Handbook of Nature Study*,* of *D. Lange*, of St. Paul, Minnesota, which teaches how system may be introduced into this occupation. In it, the author has undertaken to point out some of the material which may be made the basis of profitable lessons in Nature study, and to show how this material may be made available, and what the pupils may be taught about it. The author has arranged the matter of the subject of his teachings according to seasons and life communities. He begins at home in the spring, and directs the wanderings of the pupils to the waters, fields, and prairies, the roadsides and neglected corners, studying besides the plants and animals, the geological action of water, the flowers of the fields and the needs of neglected places, window flowers, and domestic animals. Then he goes to the woods—in spring, in summer, and in autumn—and their plant and animal life, the effect of all these upon the earth, and their relations to one another. Some practical precepts are given to teachers concerning the method of conducting the study of Nature.

In the presentation of his conception of *The State*,* or the Elements of Politics, Prof. *Woodrow Wilson* has taken a comprehensive view. Designing a book for study and instruction, he has sought to set forth the evolution of existing systems of government from the beginning. Possessing no model, no text-book of like scope and purpose having apparently hitherto been attempted, he has had to make his own type; and, in the absence of anything else to refer the student to, has been obliged to include much that might otherwise have been omitted. The volume is consequently large; but this disadvantage, if it be one, is compensated for by the fact that the student has the whole subject before him. For his descriptions the author has chosen governments which are types of their several kinds. An indispensable prerequisite to studies of things of this sort is a knowledge of the constitutions of the states of classical antiquity; hence the institutions of Greece and Rome are studied: Greece, which furnished the spirit and inspiration under which the world has advanced; and Rome, which laid the foundations of modern jurisprudence. Before these, even, a glance at The Earliest Forms of Government, their Origin and Evolution, was required. Then, coming to modern systems, which are also traced in their historical development, "the government of France serves excellently as an example of a unitary government of one kind, and Great Britain equally well as an example of a unitary government of another kind; Germany exhibits a federal empire, Switzerland a federal republic of one sort, the United States a federal republic of another; Austria-Hungary and Sweden-Norway show the only two existing European

* Handbook of Nature Study for Teachers and Pupils in Elementary Schools. By D. Lange. New York: The Macmillan Company. Pp. 329. Price, $1.

* The State: Elements of Historical and Practical Politics. By Woodrow Wilson. Revised edition. Boston: D. C. Heath & Co. Pp. 656. Price, $2.

types of dual monarchies." Russia might have been presented as having a place apart in European politics, but the book was full. The work has been prepared in the belief that "our own institutions can be understood and appreciated only by those who know other systems of government as well and the main facts of general institutional history." The accounts of the particular systems of government are followed by short chapters on the Nature and Forms of Government; Law, its Nature and Development; the functions and the objects of government; and summaries, in which the conclusion is expressed that law grows with the growth of the community, can not leap too far ahead of it, and must not lag behind it; and that "the method of political development is conservative adaptation, shaping old habits into new ones, modifying old means to accomplish new ends."

Mr. *H. E. Parkhurst* has made in his *How to Name the Birds** a book on a different plan from the other books about birds that are now appearing so abundantly—not to rival them, but to serve as an introduction to their more general use. It is intended to aid the field ornithologist in determining an unknown species, by calling his attention to their more obvious features and those more distinguishable from a distance than those which observers using the ordinary bird books have to depend on as a means of recognition. Color is chiefly relied upon, and, as a further means of finding the birds, they are grouped by the seasons, when they may be seen in a given locality—the summer, winter, migrant, and permanent birds, and birds of prey. The first four groups are subgrouped according to color, and the larger color groups are further subdivided. Other devices and signs are contrived, so that a complete description of the bird, as it will appear to the amateur watching it from a little way off, is given in three or four lines. To this a brief comment is added regarding the nesting and habits of the bird. These descriptions are preceded by an analytical key similar to the botanical keys; and the study is aided by giving three pages of diagrams illustrating the distinctive areas of the bird's body, to which reference is made in describing the colors, stripes, and spots. The list comprises only those birds that are normally found within the territory described in the title as regular summer or winter visitants, as migrants, or as permanent species.

* How to Name the Birds. A Pocket Guide to the Land Birds and to the Principal Water Fowl normally found in the New England States, New York, Pennsylvania, and New Jersey, for the Use of Field Ornithologists. By H. E. Parkhurst. New York: Charles Scribner's Sons. Pp. 115. Price, $1.

A very important contribution to the economy of city administration is the quarterly *Supplement to Municipal Affairs*, June, 1898, in which the late superintendent of street cleaning in the city of New York, *George E. Waring*, Jr., presents his observations on street-cleaning methods in European cities, and general reports of his own work in that line. The observations in Europe, made in the summer of 1896, in a special study of the subject, for the information and improvement of Mr. Waring's own department, include accounts of the conditions as to cleanliness and the methods of doing the work in Vienna, Budapest, Munich, Berlin, Cologne, Brussels, London, Birmingham, Paris, Turin, and Genoa. Mr. Waring finds that the regulations under which the streets are really kept clean in those cities are no better than ours; "but there is the immense difference that in Europe laws and ordinances mean something and are executed, while here they are treated as mere matters of form." The reports of Mr. Waring's own work in New York embrace a review of the general operations of the department, the report of the snow inspector, and an account of the highly successful plan for the adjustment of labor questions instituted by Mr. Waring.

Mr. *Lauros G. McConachie*, in the study and development of legislative methods which he publishes under the title of *Congressional Committees* (T. Y. Crowell & Co., New York, $1.75), assumes that a complete breakdown of parliamentary machinery took place on the floors of Congress under the sudden and vast augmentation of legislative burdens which our senators and representatives had to confront after the civil war. Two schools of reformers came to the front, one of which held up the British parliamentary system as a model and directed attention abroad in the search for light; while the other stood up for the defense of American legislative methods as developments of American political conditions. The author has sought a mean between these schools, and has tried to glean from contemporary debates, memoirs, newspapers, and other records the reasons assigned for each innovation as it has entered and enlarged the codes, and has taken the testimony of contemporary legislators upon the conditions prevailing in successive stages in the history of the national House and Senate. Among the lessons presented by the book are those of the tremendous power wielded by the speaker of the House of Representatives and of "other anomalies in a supposed elective folk congress."

Whittaker's Mechanical Engineer's Pocket Book, prepared by *Philip R. Björling*, if it does not contain everything, contains a great many facts and formulas concerning matters on which the mechanician is often called upon to seek immediate information, a considerable proportion of which are not easily subject to systematic classification. Among the one hundred and thirty formulas and processes are those relating to the flow and force of water and wind, the pressure of gases and the air, the weight, proportions, and strength of parts of machinery; stresses, rate of delivery of elevators, etc., gauges, tables of areas and circumferences, squares, cubes, fourth and fifth powers and roots, and items which can be indicated only by viewing them in detail. It is a valuable and indispensable companion for the mechanical engineer. The Macmillan Company. Price, $1.75.

M. *J. Costantin* conceives that science consists in something more than the mere accumulation, description, and classification of facts, with which too many persons confound it, and that the important thing is what the facts teach, and, as related to it or as what may help to find it out, the theories that may be deduced from them. He applies this principle to the evolution of plant life in his book *Les Végétaux et les Milieux Cosmiques* (Plants and Cosmic Media)—adaptative evolution, which is essentially a study of the operation of the various material factors of the environment on growth and development. "Guided by Goethe's ideas, he invites us to witness the incessant variations of organized existence everywhere visible in Nature," under the influence of cold and heat, light, gravity, and the aquatic medium, hoping in these studies to find new and decisive arguments in favor of transformist conceptions. He aims to show how the new characteristics produced by changes in the influence of these factors to which plants are subjected may be fixed and gradually become hereditary. (Published by Félix Alcan, Paris, in the *Bibliothèque Scientifique Internationale*.)

Mr. *A. G. Elliott's* little work on *Industrial Electricity*—a translation and adaptation from the French of Henry D. Graffigny—is the first and introductory volume of an electro-mechanical series published by Whittaker & Co., London, and the Macmillan Company, New York. The editor, in introducing the volumes, expresses the belief that there is room for them because they explain in very clear and non-mathematical language the many and various applications of electricity. Many thousand copies of the original French editions have been sold. The present volume is divided into short chapters, each dealing with a separate branch of practical electricity—its nature, the units, magnetism and induction, practical measurement, chemical generators, accumulators, dynamo-electric machinery, electric light, electricity as a motive power, electric chemistry and electro-plating, bells and telephones, and telegraphs. In the succeeding volumes of the series the more important branches of the subjects touched upon here will be treated separately and in detail.

Franklin Story Conant was born in Boston in 1870; was educated in the public schools of New England, at the University of South Carolina, and at Williams College; and was a Doctor of Philosophy, Fellow, and Adam T. Bruce Fellow in Johns Hopkins University. He showed great appetency for biological investigation and devoted himself to it, at Baltimore, Beaufort, N. C., Wood's Hole, and in Jamaica. He published a few papers of mark, and would have published many more if he had lived. He went to Jamaica in June, 1897, to continue his investigations, and worked for nearly three months on the development and on the physiology of the sense organs of the *Cubomedusæ*. After the death of the director of the expedition, Dr. J. E. Humphrey, he took the burden upon himself, and labored faithfully till he contracted yellow fever; returned to Boston, and died there September 13, 1897. His associates of Johns Hopkins University have published as a memorial volume of him his dissertation on *The Cubomedusæ*, which he presented at the examination for the degree of Doctor of Philosophy in June, 1897, accompanied by a brief notice of his life and a portrait.

Frederick H. Ripley and *Thomas Tapper*' authors of the Natural Music Course, have arranged *A Short Course in Music*, consisting of two books, for use in schools in which the more complete course is deemed unnecessary or impracticable. In both books familiar songs are made the basis of elementary music instruction. In these songs the compositions of the best song writers are represented. Exercises in two and three parts in simple form are included in the course. A brief summary of elementary theory is inserted in the appendix. Few definitions are given, the thought of the learner being so directed as to render them either unnecessary or obvious. In the cultivation of tone and expression the authors insist that it is the mind rather than the vocal organs that at first needs attention. "If the pupil hears the ideal tone he will almost instinctively imitate it." A number of portraits of composers are given in connection with the songs. (American Book Company. Price, 35 cents.)

Mr. *Alfred Still*, believing that there was still room for a small book in which the principles determining the behavior of single-phase alternating currents under various conditions should be considered less from the point of view of the man of science than from that of the engineer, offers *Alternating Currents of Electricity and the Theory of Transformers* for the place. The book has been written, not only for engineering students, but also for those engineers who, while having extensive practical knowledge of the subject, are yet anxious to get a correct elementary idea of the leading principles involved. Graphical methods are used throughout, and the introduction of mathematics has been carefully avoided. (Published by Whittaker & Co., London; The Macmillan Company, New York. Price, $1.50.)

A paper by *A. B. Stickney*, president of the Chicago Great Western Railway Company, on *The Currency Problems of the United States in 1897–'98*, takes the ground that currency is the creature of commerce; that legislation has nothing to do with it; that its problems are purely economical; and that the only thing that can be done for it is to improve the machinery of exchanges.

A valuable and useful publication is New York *State Library Bulletin*, *Legislation, No. 9*, containing a summary of legislation by States in 1897. This is the eighth annual number of the series, and its purpose is to show at a glance what laws have been passed by States on any subject, except those of purely local interest. The summaries, though concise, so well cover the principal points of the laws cited that consultation of the text of the laws may often be dispensed with. Constitutional amendments receive special treatment. The references in the present bulletin cover thirty-six States and three Territories.

Two memoirs, published under one cover by the Peabody Institute of American Archæology and Ethnology, relate to explorations by *George Byron Gordon* in two districts of Honduras, affording relics different in character. The work at the ruins of Copan having been suspended during 1896 and 1897 by some act of the Government of Honduras, Mr. Gordon had to turn his attention elsewhere, to explorations the results of which are given under the titles of *Researches in the Uloa Valley* and *Caverns of Copan, Honduras.* The investigations in the Uloa Valley afforded a rich fund of objects of interest and of novel character—pottery adorned with elaborate and remarkably artistic designs, stone images, whistles, terracotta stamps, and only one idol. Human remains, of the most meager description, in connection with the pottery furnish reasonable evidence of burial places, but, being only crumbling fragments of bone, are too minute to supply any information respecting the form of burials or the relative position of the objects associated with them. The conclusions are drawn that the valley was at one time well populated, but not for any length of time occupied by the people whose ruined buildings of stone are found in the region up to southern Mexico, and that it was visited by several distinct peoples in ancient times. Some mounds covered with stone were discovered which deserve further investigation. Five caves of different size and character, described in the second memoir, were explored near Copan, and afforded objects peculiar to themselves and evidences of sepulture. They were very dusty, although stalactites had formed in some of them, and, although undoubtedly used by man many centuries ago, they do not seem to indicate a constant occupation for an extended period of time, or to furnish evidence of an extreme antiquity of man in the region. The most striking feature about them is probably the entire difference in character of the pottery from that found at Copan, only a few miles away, and its want of resemblance with the pottery of any other locality with which the author is familiar.

A series of Bulletins, *Some Miscellaneous Results of the Work of the Division of Entomology*, of the United States Department of Agriculture, is intended to furnish such material as was formerly published in Insect Life, presenting the results of observations made in the office of the bureau which are not extensive enough upon any one topic to form an independent and complete bulletin. The second number contains notices by different authors, mostly connected with the bureau, on twelve insects predatory on economical plants, with numerous "general notes" and correspondence.

Under the Stars, and Other Verses, is a small collection of ballads, relating chiefly to naval fights, by *Wallace Rice* and *Barrett Eastman*, published by Way & Williams, Chicago. It is dedicated "to the wider patriotism," and appears well adapted to inflame the martial spirit, which is in this country already excited to an extremely unhealthy extent.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Bulletins and Reports. Cornell University: No. 150. Tuberculosis in Cattle and its Control. By James Law. Pp. 30; No. 151: Gravity or Dilution Separators. By H. H Wing. Pp. 12.—Purdue University: No. 72. Field Experiments with Wheat. Pp. 12. —United States Department of Agriculture. Biological: No. 9. Cuckoos and Shrikes in their Relation to Agriculture. By F. E. L. Beal and S. D. Judd. Pp. 26: No. 10. Life Zones and Crop Zones of the United States. By C. Hart Merriam. Pp. 79; No. 11. The Geographic Distribution of Cereals in North America. By C. S. Plumb. Pp. 24; Botany: No. 20. Principal Poisonous Plants in the United States. By V. K. Chesnut. Pp. 60.

Alexander, Archibald. Theories of the Will in the History of Philosophy. New York: Charles Scribner's Sons. Pp. 353. $1.50.

Allen, Alfred H., and Leffmann, Henry. Commercial Organic Analysis. Third edition. Vol. I. Philadelphia: Blakiston's Son & Co. Pp. 557. $4.50.

Babbler, The. Semimonthly. June and July, 1898. New York: E. Rock, 406 Fourth Avenue. Pp. 8. 10 cents. $2 a year.

Baillière, J. B., et Fils, 19 Rue Hautefeuille, Paris. Revue Mensuelle de Bibliographie Scientifique (Monthly Review of Scientific Bibliography), August, 1898. Pp. 20.

Carter, J. M. G. Advances in the Domain of Preventive Medicine. Waukegan, Ill. Pp. 13.

Chemical Publishing Company, Easton, Pa. Catalogue. Pp. 26.

Columbia University Bulletin, June, 1898. Pp. 102, with plate.

Creighton, J. E. An Introductory Logic. New York: The Macmillan Company. Pp. 392. $1 10.

Drake, N. F. A Geological Reconnaissance of the Coal Fields of the Indian Territory. Leland Stanford, Jr., University, Palo Alto, Cal. Pp. 96.

Fitz-Maurice-Kelly, James. A History of Spanish Literature. New York: D. Appleton and Company. (Literature of the World Series.) Pp. 423. $1.50.

Holden, Edward S. The Earth and Sky. A Primer of Astronomy for Young Readers. (Appletons' Home-Reading Series.) New York: D. Appleton and Company. Pp. 76, with plates. 28 cents.

Hering, Rudolph, New York. Dilution Process of Sewage Disposal. Pp. 9.—Bacterial Processes of Sewage Disposal. Pp. 14.

Industrialist, The. Ten times a year. June, 1898. Kansas State Agricultural College, Manhattan. Pp. 80. $1 a year.

Iowa Geological Survey, Vol. VIII. Annual Report for 1897, etc. Samuel Calvin, State Geologist. Pp. 427.

Japan-American Commercial Journal. Monthly. Tokyo (Japan) Commercial and Industrial Association. (English and Japanese.) Pp. 80.

Jordan, David Starr. Lest we Forget (address to graduating class). Pp. 36.—Description of a Species of Fish (*Mitsukurina owsteni*) from Japan, the Type of a Distinct Family of Lamnoid Sharks. Pp. 8, with plates.

Kindergarten. The, Review. Monthly. Springfield, Mass.: Milton Bradley Company. Pp. 64. $2 a year.

Lambert, P. A. Differential and Integral Calculus; for Technical Schools and Colleges. New York: The Macmillan Company. Pp. 245. $1.50.

Luce, W. B., Hingham Centre, Mass. Kites and Experiments in Aërial Photography. Pp. 32. 25 cents.

MacCurdy, George Grant, and Mohiliansky, Nicolas. Indices Ponderaux du Crane (Weight Indices of the Brain). Paris. Pp. 16.

MacClure, Theodore R. A Quarter-Century of Public Health Work in Michigan. Lansing. Pp. 48.

Mivart, St. George. The Groundwork of Science. A Study of Epistemology. New York: G. P. Putnam's Sons. Pp. 328. $1.75.

Musick, John R. Lights and Shadows of our War with Spain. New York: J. S. Ogilvie Publishing Company. Pp. 224.

Muter, John. A Short Manual of Analytical Chemistry, Qualitative and Quantitative—Inorganic and Organic. Second American edition. Philadelphia: Blakiston's Son & Co. Pp. 228. $1.25.

New Jersey, Geological Survey of. Annual Report of the State Geologist for 1897. Pp. 368.

New World, The. A Quarterly Review of Religion, Ethics, and Theology. September, 1898. Boston: Houghton, Mifflin & Co. Pp. 200. 75 cents. $3 a year.

New York State College of Forestry at Cornell University. Announcement. Pp. 40.

Shufeldt, Dr. R. W. On the Alternation of Sex in a Brood of Young Sparrowhawks. Pp. 4.

Smith, William B. Infinitesimal Analysis. Vol. I. Elementary; Real Variables. New York. The Macmillan Company. Pp. 352. $3.25.

Thomson, J. J. The Discharge of Electricity through Gases. New York: Charles Scribner's Sons. Pp. 203. $1.

University of Tennessee Record. Knoxville. Pp. 80.

Venable, F. P., and Howe, J. L. Inorganic Chemistry according to the Periodic Law. Easton, Pa.: The Chemical Publishing Company. Pp. 266. $1.50.

Wilson, L. L. W. History Reader for Elementary Schools. New York: The Macmillan Company. Pp. 403. 60 cents.

Wright, Mabel Osgood, and Chapman, Frank M. Four-footed Americans and their Kin. New York: The Macmillan Company. Pp. 432. $1.50.

Fragments of Science.

Carbonic Acid and Glaciation.—In a paper on Hypotheses bearing on Climatic Changes, Prof. T. C. Chamberlin takes up a suggestion of Tyndall's that the periods of terrestrial glaciation might be dependent upon the carbon dioxide of the atmosphere, the peculiar competence of which to retain solar heat he had demonstrated. Following out the doctrine of atmospheric loss on its own lines, although only in a tentative way as yet, he seems to find a rhythmical action that may in part explain the glacial oscillations. The idea, he says, hinges on the action of the ocean as a reservoir of carbon dioxide, and on the losses of the organic cycle under the influence of cold. Cold water absorbs more carbon dioxide than warm water. As the atmosphere becomes impoverished and the temperature declines, the capacity of the ocean to take up carbonic acid in solution increases. Instead, therefore, of resupplying the atmosphere in the stress of its impoverishment, the ocean withholds its carbon dioxide to a certain extent, and possibly even turns robber itself by greater absorption. So also, with increased cold the progress of organic decay becomes less active, a greater part of the vegetal and animal matter remains undecomposed, and its carbon is thereby locked up; and hence the loss of carbon dioxide through the organic cycle is increased. The impoverishment of the atmosphere is thus hastened and the epoch of cold is precipitated. With the spread of glaciation the main crystalline areas whose alteration is the chief source of depletion become covered and frozen, and the abstraction of carbon dioxide by rock alteration is checked. The supply continuing the same, by hypothesis, re-enrichment begins, and when it has sufficiently advanced warmth returns. With returning warmth the ocean gives up its carbon dioxide more freely, the accumulated organic products decay and add their contribution of carbonic acid, and the re-enrichment is accelerated and interglacial mildness is hastened.

Additions to the Missouri Botanical Garden.—We learn from the ninth annual report of the Missouri Botanical Garden that while the decorative features were maintained in 1897 in about the same manner as heretofore, considerable additions have been made in certain classes, especially orchids, and the collections of cultivated species, with their named varieties, are now estimated to number about five thousand. Circumstances made possible material additions to the contents of the herbarium; and, besides the purchased current collections, rather larger and more numerous than usual, the garden has secured the herbarium of the late J. H. Redfield, very rich in earlier collections representing the flora of the United States; the herbarium of the late Dr. J. F. Joor, containing 4,133 specimens, and largely adding to the representation of the flora of Louisiana and Texas; the interesting herbarium of Gustav Jermy, of San Antonio, Texas, containing a very full set of Carpathian plants and a nearly complete local flora; the important pre-Linnæan herbarium formed by Boehmer and Ludwig; and a Chinese collection by Dr. A. Henry. Even larger additions were made to the library. The instruction of garden pupils was continued, and the garden was visited by several research students. Among the scientific papers accompanying the report and bound with it are those of C. H. Thompson on American Lemnaceæ; N. N. Glatfelter on *Salix longipes;* H. C. Irish on the Genus Capsicum; A. S. Hitchcock on Cryptogams collected in the Bahamas, Jamaica, and Grand Cayman; J. N. Rose on Agaves; C. H. Thompson on Cacti Anhalonium; and seven shorter papers under the heading of "Notes and Observations."

The Indian Idea of the "Midmost Self."—In attempting to explain the significance of a pentagonal stone dodecahedron with vestiges of figures on it found near Marietta, Ohio, Dr. J. C. Morris assumed that, besides the Aryan idea of three dimensions of space, there is, to the Indian and to the Eastern mind, another—the fullness. "It is not the length and breadth and thickness of a cube, for instance, but the whole of it, which is as much to be considered as any one of its sides. A cube would therefore be represented numerically by seven, a dodecahedron by thirteen. Among the Mexicans the thirteen lunar months would thus correspond in the year with the twelve zodiacal signs and the earth which passed under and embraced them all." Again, the five digits came to be a measure of man's power or individuality, and thus a sacred number. A pentagonal dodecahedron, then, might be the emblem of the world; and the best time to be active in some contemplated pursuit might be shown by the zodiacal sign that came uppermost when the dodecahedron was thrown or rolled with appropriate ceremonies. As Mr. Frank H. Cushing interpreted the doctrine at the same meeting of the Anthropological Society, when the primitive man contemplates or considers himself or anything in its relation to space or the surrounding directions, "he notices that there is ever a front or face, a rear or back; two sides, or a right and a left; a head and a foot, or an above and a below; and that of and within all of these is himself or it; that the essence of all these aspects in anything is the thing itself—that is, the thing that contains their numbers or sum, yet is one by itself. This is indeed the very key to his conception of himself and of anything in relation to space and the universe or cosmos. He observes that there are as many regions in the world as there are aspects of himself or sides to any equally separate thing; that there are as many directions from him or his place in the world (which is his 'midmost' or place of attachment to the Earth-mother), or from anything in the world (which is its midmost or natural station), toward these corresponding regions. Hence to him a plane would be symbolized not by four, but by five—its four sides and directions thence, and its central self—as was actually the notion of the prairie tribes; a cube, not by six, but by seven, as was the notion of the valley Pueblos and Navajos; a dodecahedron, not by twelve, but by thirteen, as was the notion of the Zuñis, the Aztecs, and apparently—from this example—of the mound builders as well."

The Bactrian Camel for the Klondike.—The great Siberian or Bactrian camel is recommended by Mr. Carl Hagenbeck, the famous Hamburg importer of wild beasts, as the best animal for the Klondike climate. It is at home in the coldest regions, can carry or go in harness, can cross mountains or traverse valleys, and is so easily supplied that Mr. Hagenbeck can undertake to deliver any number in New York, duty paid, for three hundred dollars each. It can endure thirst and long spells of hunger as well as freezing cold, and is not too delicate to make its bed on the snow. It sheds its coat before the summer heat, but as the cooler weather of the fall comes on "it grows a garment of fur almost as thick as a buffalo robe and equally cold-resisting. It is far more strongly built than the southern camel. It does not 'split' when on slippery ground, though it falls on moist, wet clay which yields to the foot. On ice and frozen snow it stands firmly, and can travel far." It is said that an excellent cross can be made between the male Bactrian and the female Arabian camel; but when the parentage is reversed the progeny is useless. General Harlan is said to have marched two thousand Bactrian camels four hundred miles and crossed the Indian Caucasus in ice and snow, with the loss of only one animal, and that by an accident. This camel is native to the high plateaus, steppes, and deserts of Mongolia and South Siberia, and it has been found wild on the plain of Tsaidam, maintaining itself in this "arid, cold, and waterless region, where the herds are said to travel seventy miles to drink. Nothing," we are further told, "but too much comfort or a damp climate seems to hurt it. For food it prefers dry, salty plants and bushes and grows sick and lean on good pasture. The salty efflorescence of the steppes is eagerly eaten by it, and in this country it prefers dry food, especially wheat straw and hay. Prjevalski's camels would eat almost anything—straw, bleached bones, old pack saddles, straps, and leather. The Mongols told him of camels which had been without food a long time, and then devoured an old tent belonging to their owner. They even ate meat and fish, and one of the traveler's camels made a meal of the bird skins ready for stuffing."

Nicaragua and its Ferns.—Tropical America is described by B. Shimek, in a paper on the Ferns of Nicaragua, as the fern paradise of the earth. "No other corresponding division of the earth's surface," he says, "presents as great a total number of species, or as many species which are peculiar to it. Nowhere else is the great variation in form and size, in structural characters and habits of growth, and in the arrangement and character of the reproductive organs, better shown than here. This richness in the fern flora, exhibited in almost unlimited variety, is, no doubt, accounted for by the topography and contour of that part of the American continent which lies within the tropics. It is narrow when compared with the continents of the Old World, and it contains high mountain chains, which form its longest axis. Its narrow form brings all of it more or less within the influence of the adjacent oceans, which furnish to most of it an abundance of moisture. Its high mountains supply all the conditions effected by altitude, and, moreover, cut off the otherwise abundant moisture from certain areas. We have thus within comparatively restricted limits all the possible degrees of moisture and temperature, and the effect of environment finds abundant expression in the great variety of fern structures." After palms, ferns form the most conspicuous feature of tropical vegetation, and in size they vary from species only a fraction of an inch high to splendid tree ferns or vines single fronds of which are more than thirty feet long. In texture "some rival the flimsiest lace, while others develop thick, leathery fronds. . . . In habit the variation is fully as great. In western Nicaragua, for example, where there is a distinct dry season, ferns growing on bare volcanic rock become so dry that they may be ground to powder between the fingers, and yet they retain life; while in the eastern part, with its deep jungles in which perpetual shade and moisture prevail, the more delicate as well as the more gorgeous forms have full opportunity for the development of their many peculiarities." In a very small territory of Nicaragua, including a strip along the San Juan River in no case extending more than six miles away from it, and in the little island of Ometepe in Lake Nicaragua, Mr. Shimek, in less than four months, while engaged in general botanical work, collected more than a hundred and twenty species of ferns; and yet only about one fifth of one hundred and twenty-one species recorded by Fournier, two fifths of one hundred and thirty-five species credited by Hemsley to Nicaragua, and two fifths of those reported by Baker and Hemsley from adjacent Costa Rica, occur in his list.

Wave Length and other Measurements.—Describing the measurement of absolute wave length before the Astronomical and Physical Society of Toronto, Mr. A. F. Miller remarked that a somewhat incorrect idea prevailed as to the smallness of the space occupied in the performance of luminous undulations; in fact, some people seem to regard the wave length of light as something almost inconceivably small. Really, however, we are familiar with much smaller dimensions. For instance, the author had found from actual measures that the wave length of one of the characteristic lines in the spectrum of sodium vapor was very nearly equal to $\frac{1}{42000}$ of an inch. The thickness of ordinary gold leaf is given as $\frac{1}{282000}$ of an inch, from which it becomes evident that the wave length of sodium light, which is an average wave length for the visible spectrum, is six and a half times as great as the thickness of gold leaf. Such a dimension as $\frac{1}{42000}$ of an inch could readily be measured by a suitable micrometer; but of course the waves of light, as well as the ether particles by which they are transmitted, are entirely invisible, and even were this otherwise the frequency of the undulations is so inconceivably great that the actual phenomena of the movements could never become perceptible. In measuring the absolute wave length, therefore, we are forced to take the indirect method of observing the results of undulations in cases where, by a suitable arrangement of the experiment, equal and opposite phases of vibration are made to arrive simultaneously at the same spot, so producing phenomena of interference.

The "Causses" of Southern France.—It is surprising to find existing, in a country so old and supposedly so familiar as France, a region similar to our Colorado plateau, full of cañons, caves, and cliff dwellings, until recently almost unknown and wholly unexplored. Yet such is the region of the Causses, described and illustrated with a striking series of lantern views, before the American Association for the Advancement of Science, by the well-known cave explorer, Dr. H. C. Hovey, of Newburyport, Mass. The local name Causse, derived from the Latin *calx*, lime, is applied to a limestone area, and here to a limestone plateau. Along the western slope of the Cévennes Mountains lies an elevated table-land, chiefly of Jurassic limestones, which had been cut and carved by the streams, especially the Tarn and its affluents, into a group of high plateaus separated by deep cañons. The cliffs of the Tarn Valley are from one to two thousand feet and even more in height, and with their precipitous sides and the brilliant and varied coloring of their strata are not unworthy of comparison with our own great cañon regions of the West. At some points, where the beds are markedly unequal in hardness, the weathering process has resulted in structures as remarkable as Monument Park or the Garden of the Gods. Such is the "rock city" known as Montpellier-le-Vieux, at the junction of the Jonté and the Durbais, on the Causse Noir. This strange area of natural ruins covers some two thousand acres with a fantastic similitude of castles, palaces, streets, and temples. It seems surprising that a country so picturesque for the tourist and so interesting for the geologist should have remained almost unknown till the present time. Fine roads pass over and around it, but they avoid the wild and rugged portions that possess such scenic interest, and leave the Causses—as they have been for ages—barren solitudes, occupied only by shepherds with their huts and flocks. The people, also, as is so often the case in such regions, have a superstitious dread of the deeper caverns and the seeming ruins, and do not lend themselves readily to exploration. The cliffs are full of caves, some of which—the more accessible and simple—are used as sheepfolds, and even in some cases inhabited, but the wilder ones are held in dread. It seems that cliff dwellings are actually still in use to some extent in this region. The French Société de Spéléologie has now for some years been investigating the Causses with great interest. Ere long this will become a favorite region for tourists; but at present one must leave all ordinary facilities of travel and take to canoes and mules. This was done by Dr. Hovey and his party, under the leadership of M. Edouard A. Martel, of Paris, who has been one of the most active explorers. They entered and traversed many remarkable caves, some never before visited, and some that have been previously explored by M. Martel and others of the société. One of these, known as the Baumes Chaudes, is a great triple cavern, one of the main branches of which had yielded a large number of prehistoric skeletons to Dr. Prunières, of Marvejol. In the third division are a number of deep pits, locally called "wells," from forty to a hundred and thirty feet deep; these communicate with lower passages and subterranean streams. They are death-traps to animals, the remains of which, of many kinds and in all stages of decomposition, accumulate at the bottom, and are gradually covered by stalagmitic deposits. Another remarkable cave was discovered and named after its daring and enthusiastic explorer, M. Louis Armand, of Paris. It can only be entered by a "well" two hundred and forty feet deep, and below this lies another of still greater depth. The party was provided with rope ladders for use in such places; and the intrepid investigator who essayed the descent went down, by actual measurement, six hundred feet from the surface. He described the stalactites as magnificent. Both from a geological and an archæological point of view this account was of unusual interest. Dr. Hovey had many beautiful views of the cañons and the cave openings in their walls; while his observations, and those of the Société de Spéléologie, are very curious as to the persistence, in this strangely overlooked region, of conditions closely akin to what are usually called "prehistoric" times.

Molecular Asymmetry and Life.—Speaking in his presidential address to the Chemical Section of the British Association on Stereochemistry and Vitalism, Prof. A. R. Japp expressed the conclusion that "the production of single asymmetric compounds or their isolation from the mixture of their enantiomorphs [or opposite forms] is, as Pasteur firmly held, the prerogative of life. Only the living organism, with its asymmetric tissues, or the asymmetric productions of the living organism, or the living intelligence with its conception of asymmetry, can produce this result. Only asymmetry can beget asymmetry. The absolute origin of the compounds of one-sided asymmetry is a mystery as profound as the absolute origin of life itself. The two phenomena are intimately connected. . . . No fortuitous concourse of atoms, even with all eternity for them to clash and combine in, could compass this feat of the formation of the first optically active organic compound. Coincidence is excluded, and every purely mechanical explanation of the phenomena must necessarily fail. I see no escape from the conclu sion that at the moment when life first arose a directive force came into play—a force of precisely the same character as that which enables the intelligent operator, by the exercise of his will, to select one crystallized enantiomorph and reject its asymmetric opposite. I would emphasize the fact that the operation of a directive force of this nature does not involve a violation of the law of the conservation of energy."

Dr. Russell's Photographic Researches.—At the recent meeting of the British Association at Bristol, Dr. W. T. Russell gave, before the Chemical Section, some further information regarding his recent researches on the surprising action exerted by certain substances in the absence of light on photographic plates. The Journal of the Society of Arts gives some of his more striking results: "Some ordinary type, a portion of the cover of Punch, and the wrapper of a packet of tobacco produced strongly defined pictures; the last mentioned was particularly interesting, inasmuch as the red ink had proved active, the blue inactive. Strangely, writing ink (old-fashioned) is quite inactive, and paper having writing on it in ink, even over a hnndred years old, when placed between a sheet of active material and a sensitive plate, yielded a picture in which the writing appeared quite distinctly, white on black, in spite of the original being in some cases indistinct; ferrous sulphate behaves like ink. The list of materials that are active is very long, and includes wood, which gives a picture of the grain and knots. Many metals are active, but zinc is very active only when bright, so that a dirty sheet of zinc rubbed with sandpaper gives a picture of the scratches. Many alloys are also active, pewter and fusible metal being two of them, and curiously some brasses are, while others are not. The effective agency that passes from the material to the sensitive plate shows peculiarities. It passes through gelatin, gutta-percha, celluloid, collodion, wet gum arabic, and some paper, while other paper, glass, minerals transparent to light, and many other substances are opaque to these emanations, and some striking effects were exhibited demonstrating the interference of these opaque substances when interposed between an active substance and the sensitive plate. For instance, a five-pound note placed printing downward on the sensitive plate gave a picture of the printing inscription, but when placed under a zinc plate with the printing toward the zinc plate it gave a picture of the opaque paper with the water marks distinctly showing, and, what is still more astonishing, the zinc plate, after contact with the note, itself yielded a picture of the inscription, showing that the influence from the ink had passed to the zinc plate. It was noteworthy that the signature was not in writing ink. A cutting from the Times, the paper being transparent, showed a picture of the printing on both sides; the picture, moreover, was reversible, showing that a perfect picture of both sides of the paper had been impressed on the one plate. This interesting phenomenon is, however, not quite explained, but the great amount of work he has done leads him to the provisional opinion that the effect is due to the évolution of hydrogen peroxide."

Scientific "Trade Hunting."—The recent movement in England toward the establishment by the Government of a commercial intelligence office for the securing and diffusion of information regarding foreign trade has given rise to considerable discussion among the English trade papers. The business of the office is to be the gathering of general information of interest and value to the English merchant with a foreign trade, and especially of pointing out new ways for the extension of foreign commerce, and calling attention to possible new markets for English goods. A number of schemes have been proposed, among others that of sending an expert once every year or two to the different foreign " trade areas," for the purpose of collecting information and samples, and of giving a trustworthy estimate of its commercial prospects; another, that of extending the consular reports in such a manner as to compass the same ends. There is considerable opposition to the scheme from some branches of business, where it is held that no one is so likely to get hold of useful information as the trader himself, and that the publishing of such Government reports as the scheme contemplates would result in giving the information to foreign as well as English traders, and thus negative whatever advantage might come to the English merchant from his individual discovery of a valuable market.

Dr. Neufeld.—The London Times of September 13th gives the following account of the career of Dr. Neufeld, who has just been delivered from captivity in Omdurman by the English forces: "Karl Neufeld studied medicine at Leipsic University, and went early in life to Egypt, following first his profession as a medical man and subsequently as a merchant. At the beginning of the eighties he had a practice at Keneh, Upper Egypt, where several Germans and also natives of his own home saw him. Subsequently he set up as a merchant at Assouan. After the fall of Khartoum and the firm establishment of the Mahdi's power at Omdurman, Neufeld seems to have formed a scheme for opening up commercial intercourse with the closed Soudan, for he equipped a caravan with which he proceeded to Berber, which was then in the hands of Osman Digna. The latter sent the German, whom he looked upon as a dangerous spy, to the Khalifa Abdullahi. This was in 1886. Neufeld was condemned to death, and was taken to the place of execution. He behaved there so courageously, asking to be executed like a Mohammedan, instead of suffering death by hanging, that the Khalifa was struck and respited him under the gallows. He was taken to the general prison, with heavy chains on his hands and feet, and treated altogether in a most abominable manner. He was kept alive by the women, who took pity on him and fed him, as they had done before him to Slatin. Then an endeavor was made to utilize his knowledge. He knew nothing about founding cannon, but he managed to manufacture powder, and he was also ordered to invent a machine for coining money. Owing to the escape of Father Ohrwalder and, later, of Slatin Pasha, his position became worse. He was again manacled and threatened with having his arms and feet hacked off if he should attempt to escape. There were many efforts to liberate him. The Austrian Catholic mission, induced by Father Ohrwalder, Slatin Pasha, the British Government, the German, and more especially the Austrian, representatives at Cairo, all endeavored to further the escape of Neufeld. He frequently received money, but he refused to escape, as he would not accept liberty without his wife—an Abyssinian slave presented to him by the Khalifa—and the two children whom she had borne him. The latter would have been exposed to fearful tortures, and thus Neufeld chose to remain a prisoner. He was active subsequently also as an artist, and as he could draw well he was ordered to decorate the mausoleum of the Mahdi, and this pleased the women of the Khalifa so much that they petitioned the latter for his liberation. It is also said that he has written Arabic books and illustrated them. The latter part of his twelve years' detention appears to have been less onerous, as after the escape of Slatin he had to be interpreter to the Khalifa and translator of European newspapers which the ruler of the Soudan received regularly. It is to the credit of the Khalifa Abdullahi that not one of the Christian prisoners received a hurt on the approach of the Anglo-Egyptian forces. It is expected that a narrative of his experience in the Soudan will be shortly published by Dr. Neufeld."

Natural Selection and Fortuitous Variation.—The three principal objections urged against Darwin's theory of natural selection were stated by Prof. W. F. R. Weldon, in his presidential address to the Section of Zoölogy and Physiology of the British Association, as being that the species of animals we know fall into orderly series for the selection of which purely fortuitous variations can not be supposed to afford opportunity; that minute structural variations can not be supposed to affect the death-rate so much as the theory requires they should, while many of the characters by which species are distinguished appear to us so small and useless that they can not be supposed to affect the chance of survival at all; and that the process of evolution by natural selection is so extremely slow that the time required for its operation is longer than the extreme limit of time given by estimates of the age of the earth. The first of these objections the speaker alleged to be due to a misunderstanding of words; we regard as fortuitous what we do not understand; and he proceeded to explain how what we call chance may be shown, especially by a method developed by Professor Pearson, to be a real and important factor. To the other two objections Professor Weldon opposed the results of observations of his own and of Mr. Herbert Thompson on the small shore crabs (*Carcinus mœnas*) at Plymouth Beach. "In these crabs small changes in the size of the frontal breadth do, under certain circumstances, affect the death-rate; and the mean frontal breadth among this race of crabs is, in fact, changing at a rate sufficiently rapid for all the requirements of a theory of evolution." In conclusion, he said: "I hope I have convinced you that the law of chance enables one to express easily and simply the frequency of variations among animals, and I hope I have convinced you that the action of natural selection upon such fortuitous variations can be experimentally measured, at least in the only case in which any one has attempted to measure it. I hope I have convinced you that the process of evolution is sometimes so rapid that it can be observed in the space of a very few years." The whole difficulty of natural selection, he added, is a quantitative difficulty; and he insisted upon the need of observations and measurements of the rates of variation.

The Interior of Canada.—The country between Lake St. John and James Bay is under survey by the Department of Colonization and Mines of Quebec, in furtherance of a scheme for a transcontinental railroad to tap the Hudson Bay country and Lake Winnipeg. As to the commercial advantages of a railway center established at the head of James Bay or at the limit of tide water on the Nottaway River, Mr. O'Sullivan, the surveyor, shows that the shore line of Hudson and James Bay, following the east coast from the mouth of the Nottaway to the southern entrance to Hudson Strait, measures, in a line running due north, eight hundred miles, or about the same distance as the former point is north of the city of Washington; and the western shore line, measured in the same way to Rowe's Welcome, is about sixteen hundred miles, while the area inclosed amounts to more than three hundred and fifty thousand square miles. While Hudson Strait is blocked with ice during nine months of the year, the bay itself is navigable from June till November, and James Bay is generally open early in May. All the large rivers—the Albany, Moose, Hannah, Nottaway, Rupert, Main, and Big Rivers—converge along these shores, and the forest wealth of the thousands of miles drained by these and lesser rivers can be concentrated at the mouth of the Nottaway or Rupert. The land along the line from Lake

St. John is good dry land fit for settlement. The Nottaway at the crossing point is fourteen hundred and fifty feet wide, and admits bridge spans of five hundred feet. Thence, a direct line to Norway House, at the foot of Lake Winnipeg, would pass through the gypsum beds on Moose River, and give access to a vast area of rich agricultural land in the north part of the province of Quebec. The straight line continued would strike about the forks of the Peace and Smoky Rivers, near the center of the northwest wheat-growing region, and thence follow the valleys of the Peace and Skeene Rivers to the Pacific Ocean, crossing the Rocky Mountains at a point where the summit is two thousand feet lower than that of the Canadian Pacific Railway. As to the resources of this northwestern country, there are, according to a Dominion official report, an area of six hundred and fifty-six thousand square miles along the Mackenzie River suitable for the growth of potatoes, four hundred and seven thousand suitable for barley, and three hundred and sixteen thousand for wheat, with a pastoral area of eight hundred and sixty thousand square miles, two hundred and seventy-four thousand miles of which may be regarded as arable land. "The difference in latitude makes no corresponding difference in the climate. Flowers bloom as early in the spring and as late in autumn at Great Slave Lake as at Winnipeg or St. Paul and Minneapolis. The prevailing southwest or Chinook winds render the climate along the Peace and Liard Rivers as mild and salubrious as that of western Ontario. Wheat ripens along the Mackenzie River under the Arctic Circle, a thousand miles farther north than Rupert House."

MINOR PARAGRAPHS.

Mr. W. H. Huddleston, in his presidential address to the Geological Section of the British Association, spoke of the geology of the southwest of England, and began with supporting the claim of Bristol, where the association was meeting, to be regarded as the cradle of British geology, and even more; for, he said, Devonshire, Cornwall, and West Somerset first attracted the attention of the Ordnance Geological Survey. "Thus it comes to pass that the region which lies between the Bristol Channel and the English Channel claims the respect of geologists in all parts of the world, not only as the birthplace of stratigraphical paleontology, but also as the original home of systematic geological survey. The city of Bristol lies on the confines of this region, where it shades off northwestward into the Palæozoics of Wales and northeastward into the Mesozoics of the midland counties."

A committee of the English Society of Arts, appointed to inquire into the matter, attribute the doubtful quality of modern paper to "revolutionary" changes which the industry has undergone, including the introduction of new substances of varying qualities and chemical properties, in the working up of which there is still room for much improvement. The committee have examined many books, as evidence, on the question of the deterioration of paper. They distinguish two tendencies—to disintegration and to discoloration—which are independent but may be concurrent effects, and are notably concurrent in papers containing mechanical wood pulp. Disintegration, which has been brought to light in papers of all grades, is generally the result of chemical changes in the fibers, produced by acids in the rag papers, and by oxidation in the papers made of mechanical wood pulp. Discoloration of ordinary cellulose papers, as distinguished from papers containing mechanical wood pulp, is dependent upon the quality of the sizing, and particularly the proportion of rosin in it. The committee define as the normal standard of quality for book papers, required for publications of permanent value, fibers not less than seventy per cent of the cotton, flax, and hemp class, sizing not more than two per cent rosin, the paper to be finished with the normal acidity of pure alum, and the loading to be not more than ten per cent mineral matter.

Colonel G. E. Church, president of the Geographical Section of the British Association, pointed out in his opening address, which was on Argentine geography and the ancient Pampean Sea, that the drainage area of the Plata basin was, according to Dr. Bludan, 1,198,000 square miles, or more than two and a half times that of the Pacific slope of the Andes. The minimum water discharge into the Plata estuary would, every twenty-four hours, make a lake one mile square and 1,650 feet deep. About seventy-four per cent of it would represent the flow of the Paraná, and twenty-six per cent that of the Uruguay River. These interlaced with the affluents of the Amazon along a line of fourteen degrees of longitude The author sought to show that the Plata drainage area was, in a recent geological period, much more extensive than it is to-day; that its extreme northern limit was in 10° 44′ south latitude, and that nearly all the waters that now unite to form the Madeira River, the main affluent of the Amazon, once flowed southward into a Pampean sea that penetrated north over the plains of the present Argentine Republic to about 19° south latitude.

Dr. Le Neve Foster, who nearly met his death in 1897 from carbonic-oxide poisoning while investigating a mine accident in the Isle of Man, discussing, in his report on the disaster, the origin of the gas, points out that although it occurs occluded in certain rocks and minerals, it has never been found as a natural constituent of the atmosphere of the mines. He had, therefore, to seek an artificial source, and found it in the burning of the timber in the mine. It appeared that the combustion of a cubic foot of larch, the wood used in the timber construction of the Snaefell mine, gives rise to enough carbonic oxide to occupy four hundred and seventeen feet of space at a temperature of 60° F. and a pressure of thirty inches. Twenty-five cubic feet of timber will yield sufficient to infect the atmosphere with one per cent of the gas all through the mine—enough to cause almost immediate loss of consciousness and speedy death. It is important, therefore, to avoid as much as possible the use of combustible material in the shafts and roadways of mines, unless they are constantly wet or damp. It is also well to have compressed oxygen at hand for the restoration of asphyxiated persons, and also apparatus for penetrating noxious gases.

Rafting, similar to that which formerly distinguished the navigation of the Ohio and Mississippi Rivers, and to that which is still employed by the wood dealers on the great rivers of northern Russia and Siberia, is in use among the farmers of the middle and upper courses of the Yang-tse-Kiang as a means of getting their produce to market. They join rafts till they have a surface of two or three acres, care being taken not to have them too large for the river at its narrowest passages, and on these they build veritable farmsteads, with dwelling houses, barns, stables, and pigpens, for horses, cattle, and swine; and provide supplies of hay, fodder, and provisions for beast and man, to last the human and animal population of the craft during their journey of six hundred or nine hundred miles. The men on board are not idle through this journey, but have their stock of osier twigs and spend their time making baskets and other articles. Arrived at one of the great river marts, the people dispose of their animals and products, sell the articles they have made, and find markets for the material of their rafts with the dealers in lumber and firewood—just as the Ohio and Mississippi boatmen used to do. Then they return home.

NOTES.

The New York School of Applied Design for Women, 200 West Twenty-third Street, was organized for the purpose of affording to women instruction which will enable them to earn their livelihood by the employment of their taste and manual dexterity in the application of ornamental design to manufacture and the arts. Besides eight elementary courses, it has a course in historic ornament, advanced courses in the applications of design to the manufacture of wall paper and silk, and of the elementary instruction to the work of an architect's draughtsman, and to illustrating and lithography; and special courses in book-cover designing, advanced design, animal drawing for illustration, stained glass designing, water-color painting, and interior decoration. The instructors are practical men from manufactories and architects' offices. Pupils are allowed to proceed as rapidly as they master the successive steps in the course of instruction, without having to conform to a fixed period.

Communicating to the American Association the results of experiments in fig-raising in California, Dr. L. O. Howard said that the trees produced from imported Smyrna cuttings dropped most of their fruit, whence it seemed that something was wanting. This was found to be the fertilizing insect, *Blas-*

tophora psenes, which inhabits the wild fig trees or caprifigs of the Mediterranean countries, and which the fig-growers procure by bringing down twigs of these trees from the mountains at the fertilizing season. Artificial fertilization of figs has been tried in California with considerable success; but it is thought that if the caprifig and its insect can be naturalized in California, there will be no difficulty in raising figs the equal to those of Smyrna.

Discussing at the meeting of the American Association the position of the trilobites in classification, Prof. A. S. Packard referred to the discovery of Beecher that certain genera of them have antennæ together with biramose legs, essentially the same for the head and trunk, and double, so that one portion is available for swimming and the other for crawling. He then showed that this uniformity of appendages does not occur in the *Crustaceæ*, to which the trilobites have been referred heretofore. For this reason, and because the young have a different form from crustacean young, zoölogists are inclined to refer the trilobites to a separate class and to regard them as an older, more primitive group. From certain obvious affinities, the *Limulus*, or king crab, may be regarded as a descendant from the trilobites.

On Thursday, September 15th, Mr. Stanley Spencer and Dr. Berson ascended from the Crystal Palace, near London, in a balloon inflated with pure hydrogen to the remarkable height of twenty-seven thousand five hundred feet, only fifteen hundred feet below the highest ascent of Coxwell and Glaisher. Numerous scientific instruments were carried, and also a cylinder of compressed oxygen for inhaling at great heights. It was found necessary to use the oxygen at twenty-five thousand feet.

In the discussion in the British Association of a communication by Professors E. B. Roser and W. O. Atwater recording their experiments (American) on the amount of energy supplied to and obtainable from the human body—which are found to be equal—Prof. W. E. Ayrton, presiding, pointed out that the energy of muscular action is probably capillary or electrical, the human machine being more analogous to an electric battery or motor than to a steam engine.

In the list of officers of the American Association for 1899, published in our last number. the name of L. O. Howard, of the Department of Agriculture, Washington, should have appeared as permanent secretary.

The hundredth anniversary of the invention of the voltaic or electric pile is to be celebrated in 1899 at Como, the birthplace of Alexander Volta, by an international electrical exhibition. A national exhibition of the manufacture of silk—machinery, preparation, and processes—will be held in connection with it. An international congress will also be held for the discussion of the progress and applications of electricity.

A prize of five hundred guineas is offered by the Sulphate of Ammonia Committee, 4 Fenchurch Avenue, London, for the best essay on The Utility of Sulphate of Ammonia in Agriculture; the committee to have entire disposal of the selected essay, and the refusal of any of the others for not more than fifty guineas each. The essays—in English—should be in the hands of the committee not later than November 15, 1898.

Recent death lists include the names, among men known to science, of Prof. Park Merrill, chief of the Forecast Division of the Weather Bureau, at Washington, August 8th; Dr. E. V. Aveling, late assistant in physiology at Cambridge and professor of chemistry and physiology at New College, a writer upon scientific topics, in London, August 4th, aged forty-seven years; M. Paul Sevret, mathematician and member of the French Academy of Sciences, in Paris, June 24th, aged seventy years; W. F. R. Suringer, professor of botany in the University of Leyden, and director of the Botanical Garden and Herbarium; J. A. R. Newlands, the discoverer of the periodic law of the chemical elements, in Lower Clapton, London, July 29th, aged sixty-nine years; the astronomer Romberg, who succeeded Encke at Berlin in 1864, and was called to Pulkova in 1873, author of numerous papers in Monthly Notices on double stars and planetary and cometary observations, at Pulkova, July 6th, aged sixty-four years; John Hopkinson, an eminent British electrician, president of the Institute of Electrical Engineers in 1890 and 1896, killed with his three children in an attempt to ascend the Dent de Visivi, Alps, August 24th; Dr. H. Trimble, professor of practical chemistry in the Philadelphia College of Pharmacy, and editor of the American Journal of Pharmacy; M. de Windt, geologist of the Belgian Exploring Expedition to the Congo, drowned in Lake Tanganyika, Africa, August 9th; Dr. Paul Glan, assistant professor of physics in the University of Berlin, aged fifty eight years; Dr. E. J. Bonsdorf, formerly professor of anatomy and physiology at Helsingfors, Finland, aged eighty-eight years; Dr. Robert Zimmerman, formerly professor of philosophy in the University of Vienna, at Salzburg, Austria, aged seventy-seven years; M. J. M. Moniz, known by his investigations of the natural history of Madeira, at Madeira, July 11th, aged sixty-six years; and M. Pomel, a distinguished French mining engineer, professor of geology and past director at the Algiers Scientific School, and author of a number of special works, at Oran, Algeria.

CHARLES H. HITCHCOCK.

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THE WHEAT-GROWING CAPACITY OF THE UNITED STATES.

By EDWARD ATKINSON.

IN 1880 it happened to fall to me to make a forecast of the very great reduction in the price of wheat in Great Britain, which could then be predicated on the lessening cost of transportation from Chicago to the seaboard, thence to British ports, which was then sure to be soon followed by a large reduction in the railway charges for bringing the wheat to Chicago from the other Western centers of distribution. I then alleged that the time was not far off when, even if the price of wheat in Mark Lane were reduced from the then existing rate of fifty-two shillings per quarter to thirty-four shillings, it would still yield as full a return to the Western farmer as it had yielded in previous years at fifty shillings and upward. This forecast attracted great attention, and has since been made the subject of very much bitter controversy, especially since the fall in prices was much more rapid than I then thought it could be, and was carried to a much lower point than any one could have then anticipated. It will be remarked that thirty-four shillings in Mark Lane is at the rate of one dollar and three cents per bushel of sixty pounds.

From time to time I have almost been forced to defend the position then taken, notably when asked to appear before the Royal Commission on Depression in Agriculture at one of their sessions, where I was kept upon the stand for two full days in the effort of the excellent English farmers and landowners to prove that the American farmer had been ruined by the reduction in the price of wheat, which the majority of that commission attributed to the demonetization of silver. The whole tone of that investigation and of a large part of the treatment of the wheat question in Great Britain has been one of complaint and of alleged wrong to British agriculture because the United States had succeeded in supplying the masses of the people of the United Kingdom with cheap bread, with sufficient profit to themselves to keep up the supply.

Now comes what may be called a cry of alarm from a scientist of highest repute lest England may be deprived even of an adequate supply of wheat, and lest the price should be forced to an exorbitant point. This view of the case was stated at great length by Sir William Crookes when assuming the presidency of the British Association for the Advancement of Science at the recent meeting in Bristol. This address is published in full in the Times of September 8th, the portion devoted to the wheat question filling three out of six columns of closely printed text; the other three are devoted to a complete review of the existing conditions of science. I venture to give a few extracts which will convey to the reader the aspect of the wheat question from this essentially British point of view. Sir William Crookes begins with a sort of apology, which the writer can fully appreciate. He says:

"Statistics are rarely attractive to a listening audience, but they are necessary evils, and those of this evening are unusually doleful. . . . I am constrained to show that our wheat-producing soil is totally unequal to the strain put upon it. After wearying you with a survey of the universal dearth to be expected, I hope to point a way out of the colossal dilemma. It is the chemist who must come to the rescue of the threatened communities. It is through the laboratory that starvation may ultimately be turned into plenty."

One of the singular facts which becomes quickly apparent to any one who deals with this subject in Great Britain is the inability of the English farmer to think about agriculture except in terms of wheat. Now we have an example of our English scientist of the highest repute who seems to ignore all other grain and to predict future starvation on an expected deficiency in the supply of wheat. Sir William Crookes proceeds:

"The consumption of wheat per head of the population (unit consumption) is over six bushels per annum; and, taking the population at 40,000,000, we require no less than 240,000,000 bushels of wheat, increasing annually by 2,000,000 bushels to supply the increase of population. Of the total amount of wheat consumed in the United Kingdom we grow twenty-five and import seventy-five per cent."

He then deals with the impending scarcity, saying:

"To arrest this impending danger it has been proposed that an amount of 64,000,000 bushels of wheat should be purchased by the state and stored in national granaries, not to be opened except to remedy deterioration of grain, or in view of national disaster rendering starvation imminent. This 64,000,000 bushels would add another fourteen weeks' life to the population."

After dealing with the fact that while it might be possible for the United Kingdom to supply itself with its own wheat at an average of twenty-nine and a half bushels to the acre, he goes on to say that this would require thirteen thousand square miles of British territory, increasing at the rate of one hundred square miles per annum; but he says it would be clearly impossible to assign so large a proportion of the area of the United Kingdom to a single crop without suffering in other matters, adding:

"In any case, owing to our cold, damp climate and capricious weather, the wheat crop is hazardous, and for the present our annual deficit of 180,000,000 bushels must be imported. A permanently higher price for wheat is, I fear, a calamity that ere long must be faced."

I can imagine with what a relish the Royal Commission on the Depression of Agriculture would have received this prophecy of a permanently higher price for wheat. Sir William Crookes goes on to say:

"Wheat is the most sustaining food grain of the great Caucasian race, which includes the peoples of Europe, United States, British America, the white inhabitants of South Africa, Australasia, parts of South America, and the white population of the European colonies."

He then points out how rapidly the consumers of wheat have increased, yet failing to attribute this increase in part to the rapid reduction in the cost. He says:

"In 1871 the bread-eaters of the world numbered 371,000,000; in 1881, 416,000,000; in 1891, 472,600,000; and at the present time they number 516,500,000. The augmentation of the world's bread-eating population in a geometrical ratio is evidenced by the fact that the yearly aggregates grow progressively larger. . . . To supply 516,500,000 bread-eaters, if each bread-eating unit is to have his usual ration, will require a total of 2,324,000,000 bushels for seed and food. According to the best authorities, the total supplies from the 1897–'98 harvest are 1,921,000,000."

It will be observed that while the English average consumption is said to be six bushels, the average employed in this computation is four and a half bushels per head. He then remarks upon the large harvests for seven years, saying:

"Bread-eaters have almost eaten up the reserves of wheat, and the 1897 harvest being under average, the conditions become serious. . . . It is clear we are confronted with a colossal problem that must tax the wits of the wisest. Up to recent years the growth of wheat has kept pace with demands. As wheat-eaters increased, the acreage under wheat expanded. We forget that the wheat-growing area is of strictly limited extent, and that a few million acres regularly absorbed soon amount to a formidable number. The present position being so gloomy, let us consider future prospects."

He then deals successively with the United States, Russia, Canada, and other countries. In regard to the United States he remarks:

"Practically there remains no uncultivated prairie land in the United States suitable for wheat-growing. The virgin land has been rapidly absorbed, until at present there is no land left for wheat without reducing the area for maize, hay, and other necessary crops. It is almost certain that within a generation the ever-increasing population of the United States will consume all the wheat grown within its borders, and will be driven to import, and, like ourselves, will scramble for a lion's share of the wheat crop of the world."

It is difficult for a citizen of the United States who has given any attention to the potential of our land to conceive of such views being held by an Englishman of highest scientific intelligence. When I was in England last summer I had a long interview with the editor of one of the papers of widest influence in all Great Britain. I then remarked that there were forces in action in the United States in three or four different directions which would profoundly change all the conditions of British industry, and render the English-speaking people of the United Kingdom and the United States more and more interdependent. It is seldom that one finds more than an occasional half a column in any great English paper devoted to the subject of our economic relations and to the development either of the American iron industry, of its agriculture, or of the cotton production and manufacture. Yet, in all these branches of industry, profound changes of world-wide importance, and yet of greater importance to the people of Great Britain, are now in progress. I may venture to say that this address of Sir William Crookes marks even a more profound ignorance of the forces in action in this country than even I had ever comprehended. Sir William Crookes next submits the following computation:

"The rate of consumption for seed and food by the whole world of bread-eaters was 4.15 bushels per unit per annum for the eight years ending 1878, and at the present time is 4.5 bushels. . . . Should all the wheat-growing countries add to their area to the utmost capacity, on the most careful calculation the yield would give us only an addition of some 100,000,000 acres, supplying at the average world yield of 12.7 bushels to the acre, 1,270,000,000 bushels, just enough to supply the increase of population among bread-eaters till the year 1931. At the present time there exists a deficit in the wheat area of thirty-one thousand square miles. . . . When provision shall have been made if possible to feed 230,000,000 units likely to be added to the bread-eating populations by 1931, by the complete occupancy of the arable areas of the temperate zone now partially occupied, where can be grown the additional 330,000,000 bushels of wheat required ten years later by a hungry world? If bread fails—not only us, but all the bread-eaters of the world—what are we to do? We are born wheat-eaters. Other races, vastly superior to us in numbers, but differing widely in material and intellectual progress, are eaters of Indian corn, rice, millet, and other grains; but none of these grains have the food value, the concentrated health-sustaining power of wheat, and it is on this account that the accumulated experience of civilized mankind has set wheat apart as the fit and proper food for the development of muscle and brains."

Sir William then proceeds to deal with the salvation by chemistry. But before taking notes from that part of his address, is it not singular to remark this tendency of the scientist as well as of the English farmer to think only in terms of wheat, wholly ignoring other grains? It may be interesting to point out the exact difference in the nutrients.

Wheat flour is analyzed in the following statement:

Water		11.6
Protein	11.1	
Fats	1.1	
Carbohydrates	75.6	
Mineral matters	0.6	
Total nutrients		88.4
Potential energy in one pound	1,660 calories.	

Corn or maize meal differs only as follows:

Water		14.5
Protein	9.1	
Fats	3.8	
Carbohydrates	71.0	
Mineral matters	1.6	
Total nutrients		85.5
Potential energy in one pound	1,650 calories.	

Oatmeal:

Water		7.7
Protein	15.1	
Fats	7.1	
Carbohydrates	68.1	
Mineral matters	2.0	
Total nutrients		92.3
Potential energy in one pound	1,845 calories.	

Rye flour:

Water		13.1
Protein	6.7	
Fats	0.8	
Carbohydrates	78.7	
Mineral matters	0.7	
Total nutrients		86.9
Potential energy in one pound	1,620 calories.	

It will be remarked that the difference between maize meal and wheat flour consists only in a slightly larger proportion of fats and a slightly less proportion of protein, a matter very easily balanced by giving consideration to the other kinds of food which may be used by the bread-eater. Again, it is hardly to be supposed that the Scotchmen who listened to Sir William Crookes admitted in their minds that wheat flour possessed any greater potential energy in the development either of muscle or of mind than the oatmeal to which they have been habituated for so many generations. I doubt if any New England Yankee who had been brought up on the diet of corn (maize) bread and baked beans, the latter supplying the protein element in abundance, would admit any greater development of the muscle or brain by exclusive dependence on wheat for the bread of life. It is not, however, my purpose to deal with the relative food values of wheat and other grains; it is simply to take up this extraordinary delusion of Sir William Crookes in respect to the potential of the wheat-producing area of this country. His theory is salvation by chemistry, and he rightfully calls attention to the necessity for obtaining a cheap and abundant supply of nitrogen. All the other elements for fertilizing the soil are relatively abundant at low cost, especially in this country. Our enormous supply of the phosphates of lime and potash gives assurance on this matter, and our one deficiency, or rather the one element heretofore of high cost, has been the necessary proportion of nitrogen required to maintain an even balance in the soil.

I am surprised that Sir William Crookes should attribute so little importance to the recent discovery of the influence of bacteria, which living and dying in nodules attached to the stalks of the leguminous plants dissociate the nitrogen of the atmosphere, where the supply is unlimited, converting it to the nutrition of the plant, and thence to the renovation of the soil. Sir William deals only with the renovating qualities of clover, having apparently no comprehension of the existence of the cow-pea vine, the soya bean, the alfalfa, and many other types of legumes by which the partially exhausted soil, especially of the South, is now being renovated with great rapidity at a low cost. Sir William's hopes of nitrogen seem to be based on some method being found to save the sewage of cities, but mainly on the conversion of the water power of Niagara and other great falls to the generation of electricity and thence to the dissociation of the nitrogen of the atmosphere.

The point to which I wish to direct attention and inquiry is this alleged nearly complete taking up of the land of the United States capable of producing wheat in paying quantities. The question which Sir William Crookes puts is this: He says there is a deficit in the wheat area of thirty-one thousand square miles which must be converted to wheat-growing in order to keep up with the increasing demand of the world to prevent wheat starvation in less than one generation. It will be observed that the present necessities of the world are computed by Sir William Crookes at 2,324,000,000 bushels, of which this country will supply 600,000,000 to 700,000,000 bushels from an area of land devoted to wheat of 71,000 square miles, a fraction over two per cent of the area of the United States, omitting Alaska.

The problem may then be stated in these terms: Given a demand of the wheat-consuming population of the world for this whole supply of 2,324,000,000 bushels, this country could supply it at the present average per acre by devoting two hundred and fifty thousand square miles to this crop, or less than ten per cent of the area, omitting Alaska. We could supply the world's present demand, but of course such computations are purely speculative.

I venture to say that if a contract could be entered into by the bread-eaters of the world with the farmers of the United States, giving them an assurance of a price equal to one dollar a bushel in London, or a fraction under thirty-three shillings per quarter of eight bushels of sixty pounds each, which would yield to the American farmer from sixty to eighty cents per bushel on the farm, the land now under cultivation in wheat and not required for any other crop or for pasture would be opened in the United States which would be devoted to this service year by year as fast as the consumption called for it. In fact, there are now fully one hundred thousand square miles of land, 64,000,000 acres, fully suitable to the production of wheat at fifteen bushels to the acre, practically unoccupied in any branch of agriculture, which would be devoted to wheat on an assured price of one dollar a bushel in Mark Lane, yielding 960,000,000 bushels. Or, to limit the question yet more: Sir William Crookes states the needs of the people of the United Kingdom at the present time to be 240,000,000 bushels, increasing at a rate of less than two per cent per annum, of which twenty-five per cent is derived from her own soil. If John Bull, in place of building granaries, could offer thirty-three shillings a quarter, or one dollar a bushel, in London as a permanent price for the next thirty years, would not Uncle Sam accept the offer? and if Uncle Sam should then ask for bids among the States, are there not several single States or Territories that would take the contract each for itself?

Having put that question, I now propose to submit an inquiry in due form in order to sustain my own belief that we can supply the whole present and the increasing demand of Great Britain for the next thirty years with six bushels of wheat per head at a dollar a bushel from land situated wholly in the Indian Territory, not yet open to private entry, but which may soon be open when the Indian titles have all been purchased. Or, again, I undertake to say that the State of Texas can meet this whole demand without impairing in the slightest degree its present products of grain, cotton, wool, and meats, and without appropriating the use of more than a small fraction of the area of that single State which has not yet been fenced in or subjected to the plow to the production of wheat.

Perhaps it would be better to put a more simple proposition in order to bring out what would be perfectly feasible. Let it be assumed that the British public should really become so alarmed as to be willing to put up the granaries which have been suggested for storing fourteen weeks' consumption, or 64,000,000 bushels. That would require a very large capital which would yield no income on which there would be a heavy loss of interest and a considerable risk of damage to the wheat during the period of storage. In place of this a feasible plan would be to put up the capital which would be required for building these granaries, invest it in consols, and pledge it as collateral security for the fulfillment of a contract running for thirty years for the annual purchase of 10,000,000 bushels of wheat per month, or say 128,000,000 bushels a year, or twice the quantity proposed to be stored.

There are several large dealers in grain and provisions in the United States who would be ready to take this contract and to put up a sufficient sum of capital invested in United States bonds to serve as security for prompt delivery.

An assured supply of 128,000,000 bushels in addition to the ordinary supply might allay the fear of scarcity and high price of bread. It may here be observed that the low average crop per acre of the United States has been due to the inclusion of wheat grown on land partially exhausted by cropping or not well adapted to this grain. The all-wheat as well as the all-cotton and all-tobacco methods of ignorant farming or cropping year after year are now very rapidly giving place to varied crops coupled with an increase of product per acre. No agency has been of such service in this matter as the Agricultural Experiment Stations, now established in almost every State under the supervision of men of the highest capacity. Under this system wheat, which requires a few days of machine work in the spring and autumn, occupying very little time of the farmer himself, is rapidly becoming the surplus or money crop of farms otherwise maintained on the alternate products. Under such cultivation an average crop of twenty bushels to the acre would be assured, in many sections much more. One hundred and twenty-eight million bushels at twenty bushels per acre would require 6,400,000 acres, or ten thousand square miles. As an alternate with other crops in a rotation of four, this would call for only forty thousand square miles in varied farming. In order to satisfy the anxieties of Sir William Crookes lest land should be taken from other necessary work, this area might be divided among several States and Territories, say five thousand square miles among eight. Oklahoma (38,719 square miles) was opened to settlement only seven years since, and has yet a great deal of unoccupied land. It will this year raise 13,000,000 bushels of wheat from 850 square miles devoted to the crop. Give Oklahoma five thousand square miles, the unoccupied Indian Territory (30,272 square miles) would take all the rest as soon as open; but we may only assign five thousand square miles to that area. Five thousand more might be assigned to the limestone section of Virginia, in the valley of the Shenandoah and its tributaries; five thousand each to Kentucky (40,400 square miles) and Tennessee (42,050 square miles), while the great wheat-growing States—Kansas (82,080 square miles), Nebraska (77,510 square miles), Minnesota (83,365 square miles), and the two Dakotas (148,445 square miles)—would compete for the contract each to open a little patch of five thousand square miles, not yet adjacent to railways. We should thus have exhausted the area called for without regard to the instant competition which would come from California (158,360 square miles), Oregon (96,030 square miles), and Washington (69,180 square miles), and probably from Pennsylvania (45,215 square miles) and other Eastern or Southern States. At a dollar per bushel in London no difficulty would be found in placing this contract even without resort to Texas (265,780 square miles), which could take the whole on but a small portion of its area not yet under the plow.

The only additional measure which would then be required would be one which must come in any event—namely, the neutralization of the ports of export and import of food in the United States and Great Britain and in such other countries as may choose to join, together with the neutralization of a ferry or sea way for the transportation of the food, wherein no hostile shot should be fired and no seizure of private property permitted on the part of any nation, the condition of this understanding being that if any other nation ventured to question or contest this dedication of a neutral way for the conveyance of food to the purposes of peace, the navies of Great Britain and of the United States would be united to force its acceptance, and to sweep from the ocean the fleet of every state or nation which ventured to contest this measure. That would be a suitable measure for beginning to make a right use of navies—for the protection of commerce and for the destruction of every fleet or vessel which did not accept the principle that private property not contraband of war should be exempt from seizure upon the high seas, coupled with a declaration limiting contraband of war so that it may never be made to include customary articles of commerce, especially food, not now contraband.

The foregoing text was set in type and one hundred advance proof sheets were supplied, which have been sent by the writer to the Secretaries of Agriculture and the chiefs of the Agricultural Experiment Stations in all the States to which we look for any considerable product of wheat. The replies are so complete and so numerous as to make it impossible to incorporate a full digest of the whole case within the limits of the present article. A supplement will be prepared for a later number of this journal, in which this information will be tabulated. For the present purpose I may avail myself only of a part of the data which have been sent to me.

1. The evidence suffices to prove that there is not a State named above which could not set apart five thousand square miles for the cultivation of wheat in a rotation of four without trenching in the slightest degree upon any other crop. 2. In previous essays, in which I have dealt with the potential of the agriculture of this country, I have very guardedly computed but one half our total area of three million square miles (omitting Alaska) as being arable land, suitable for the plow. The returns now in my hands would render it suitable to increase that area to two thirds, or two million square miles subject to cultivation. 3. The area now under the plow for the pro-

duction of our principal crops for the year 1897 is given in the table below. If miscellaneous crops be added to these principal crops, the cultivated land of this country does not now exceed, and in fact does not reach, twenty per cent of the arable land, while from the cultivated portion a progressive increase in product may be expected under the impetus of improved methods of farming on lessening areas in each farm.

	Acreage.	Yield.	Product.	Price.	Value.
		Per acre.	Bushels.	Cents.	
Maize	80,095,051	23.8	1,902,967,933	26.3	$501,072,952
Wheat	39,465,066	13.4	530,149,168	80.8	428,547,121
Oats	25,730,375	27.2	698,767,809	21.2	147,974,719
Barley	2,719,116	24.5	66,685,127	37.7	25,142,139
Rye	1,703,561	16.1	27,363,324	44.7	12,239,647
Buckwheat	717,836	20.9	14,997,451	42.1	6,319,188
All grain	150,431,005		3,240,930,812		$1,121,295,766
Hay	42,426,770	1.43	60,664,876	6.62	401,390,728
Cotton	23,273,209		8,532,705	6.78	291,811,564
	216,130,984				$1,814,498,058

Maize	125,150	square miles;
Wheat	61,660	" "
Oats	40,200	" "
Barley	4,250	" "
Rye	2,660	" "
Buckwheat	1,120	" "
	235,040	" "
Hay	66,290	" "
Cotton	36,520	" "
	337,850	" "

The area under wheat in 1897 was a fraction under forty million acres, or a little less than sixty-two thousand square miles. The high price secured for that crop has led to an increase in land under wheat in 1898 to a fraction under seventy-one thousand square miles (nine thousand square miles added), on which the largest crop ever known has doubtless been raised, variously computed at the present time from 620,000,000 to 700,000,000 bushels. The area now under wheat is therefore less than four per cent of our arable land.

In order to develop our potential in wheat it will be best to limit our present consideration to three States only—namely, Minnesota, North and South Dakota—from which we derive the greater part of our spring wheat. The area of these three States is two hundred and thirty-two thousand square miles, disregarding fractions. The land which is deemed to be suitable for wheat growing is estimated by the officials from whom I have derived reports at one hundred and sixty thousand square miles. The crop of 1898 is computed at 190,000,000 bushels, a quantity sufficient to supply Great Britain with all that she needs in addition to her domestic production. It has been grown on an area of less than twenty thousand square miles, or upon one eighth part of the land of these three States only; the rest of the wheat land can be as surely and profitably devoted to the production of wheat as that part already under that crop. The fact may be recalled that the territory which now constitutes the two States of North and South Dakota began to be computed separately from other States only in 1880, when a little under 3,000,000 bushels were credited to that territory. The minimum product of these two States this year will be 100,000,000 bushels.

One of the authorities upon whom I rested for absolute information is Mr. L. G. Powers, chief of the Bureau of Labor of the State of Minnesota, in whose Annual Report for 1896 is the most exhaustive study of the grain production of the Mississippi Valley that has ever been made. I therefore do not hesitate to incorporate in this article his comments upon the proof sheets sent to him:

"The probable product of wheat in a State like Minnesota, at a fixed price, such as Mr. Atkinson mentions, can be estimated, even approximately, only by taking account of a number of such factors as the present actual and relative profit of the wheat farmer, and the probable changes that will be made in the next few years in the cost of cultivating wheat and of transporting it to London. A few of the leading well-known facts relating to these subjects may with profit be noted in this connection, and first a few words with reference to the profits of wheat raising in Minnesota.

"Whatever may be true of wheat raising in Europe, or in the Atlantic coast States of America, it can be positively asserted that the average profit of the Minnesota wheat grower has been steadily though irregularly increasing since the admission of this State to the Union in 1858. This is evidenced by the relative number and amount of farm-mortgage foreclosures in the State, as a whole, and in its several sections at the present time and in the past. Properly to use those foreclosures as a measure of the increasing prosperity of the Minnesota wheat farmer, two facts should be kept in mind. In 1880, and prior to that time, the industry of wheat growing was most fully developed in those counties which now constitute the First Congressional District. The farmers of those counties at that time depended for their income largely upon their wheat crops. Later they have adopted a highly diversified system of agriculture in which wheat is only an incidental cash crop. The exclusive cultivation of wheat now finds its seat in the counties composing the Seventh Congressional District. The lands of this district are situated about two hundred miles on an average farther from the markets of Europe than those of the First District. Notwithstanding this fact and all changes in the selling price of wheat, and all allied changes affecting the wheat industry of the State, the farm-mortgage foreclosures in the Seventh Dictrict in the five years ending with December, 1897, were relatively twenty per cent less than they were in the First District in the five years 1880 to 1884, and were forty per cent less than in the five years 1869 to 1873. To the extent represented by these figures has the average cultivation of wheat as an exclusive crop become more profitable in Minnesota than it was twenty, thirty, or forty years ago. A much greater increase of farm prosperity has taken place in those counties which have adopted a diversified system of agriculture, and made wheat an incidental cash crop.

"The growing farm prosperity in Minnesota above noted finds its highest development in the past five years, during which the selling price of wheat in London has averaged approximately one dollar per bushel, or the amount called for by the conditions stated by Mr. Atkinson. This increasing farm prosperity in Minnesota, which lessens the mortgage foreclosures of the exclusive wheat growers forty per cent in thirty years, has been the main factor in the settlement of Minnesota and the two Dakotas. It has caused the wheat grown in the territory of these three States to increase from 10,000,000 bushels in 1867 to 190,000,000 bushels in 1898. With no added profit in the business, the settlement of the vacant lands of these States and those of Montana and of the British Northwest will move on, and twenty-five years from now will find in the territory tributary to Minneapolis and Duluth not less than 400,000,000 bushels of wheat raised annually. Even then but a fraction of the possible wheat lands of the great Northwest will be under the plow. If a material increase should take place in the present average profits of the Northwestern wheat grower, the imagination of man could hardly picture the stimulus to wheat culture that would result.

"With a fixed price of one dollar per bushel in London, called for by Mr. Atkinson's conditions, the American farmers can find increased profit in two possible sources: decreased cost of transportation to London, and lessening cost of wheat production in Minnesota. A detailed analysis of the various charges that constitute the present cost of transporting wheat from the Red River Valley of Minnesota, the Dakotas, and of Manitoba to London gives reasonable assurance of a reduction in the next few years of at least five and possibly seven cents per bushel in such cost. Here is an almost certain addition, in the next few years, of from five to seven cents a bushel to the profit of American-grown wheat, providing only its average selling price in London remains practically unchanged.

"A careful study of farm methods among Minnesota farmers discloses this fact: Some wheat growers, with the best farm machinery, and employing the best methods of agriculture, make a profit in wheat raising of from ten to fifteen cents a bushel more than do their less intelligent and less progressive neighbors. Now, the tendency in the State and throughout the Northwest is to bring, by education and a general exchange of methods, the poorer farmers up to the level of the best. This change is rapidly taking place. It will not require fifteen years to realize its consummation. When the methods and facilities of the average farmer are brought up to the level of the best of the present time, this change, with the change above noted in transportation charges, will add to the average profit of Minnesota farmers in growing wheat a total of not less than fifteen and possibly of over twenty cents a bushel. Such a change would more than double the existing net profit of the wheat grower in the Northwest. Could it be maintained for a series of years, as is presupposed under Mr. Atkinson's supposition of London prices, it would furnish such an incentive to wheat growing in Minnesota and the surrounding territory as has as yet never been experienced. A million families of immigrants would pour into the great Northwest within the next twenty to twenty-five years. They would take up all the existing vacant lands of Minnesota and the Dakotas. The lands suitable for irrigation in these States and in Montana would be set to growing wheat. The wave of humanity anxious to raise wheat for a dollar a bushel in London would sweep past the boundaries of the four States mentioned, and carry the cultivation of that cereal all over Manitoba, Assiniboia, Alberta, and Saskatchewan. In these four British provinces and in the four American States. dollar wheat in London would in twenty years open more acres of good land to wheat than are now subject to the plow within their borders. Even then the beginning only would have been made to the possibilities of wheat culture in the British Northwest. Settlements would not have extended as far north as St. Petersburg in Russia; neither would settlers have trenched upon the lands with a climate as severe as that of the Russian metropolis.

"The foregoing is a brief statement of what dollar wheat in London would do for one section of North America in stimulating wheat cultivation. If that statement is based upon a true conception, as the writer believes it is, of the possibilities of the American Northwest, it demonstrates how impossible it will be to maintain dollar wheat in London for any great length of time in the future. It also shows that Mr. Atkinson is wrong in not asserting a sure continuation of that decline in wheat prices which he so fully predicted in 1880."

Cost of Shipping Wheat per Bushel from Moorhead, an Interior Point in Minnesota, to Liverpool.

	On May 27, 1898.	On July 9, 1898.	On August 20, 1898.	On September 17, 1898.
	Cts. per bu.	Cts. per bu.	Cts. per bu.	Cts. per bu.
Rate, Moorhead to Duluth	9.30	9.30	8.70	8.70
Duluth elevator and inspection charges	0.80	0.80	0.80	0.80
Lake freight, Duluth to Buffalo	1.40	1.25	1.25	1.75
Elevator charges and commission at Buffalo	1.00	1.00	1.00	1.00
Canal freight, Buffalo to New York	3.00	3.00	2.75	2.50
Elevator charges, etc., in New York	2.00	2.00	2.00	2.00
Ocean freight, New York to Liverpool	8.00	3.50	4.50	6.00
Totals	25.50	20.85	21.00	22.75

General average, 22.525 cents per bushel.

It will be remarked that Mr. Powers says I am wrong in not asserting a sure continuation of the decline in the price of wheat which I predicted in 1880. In setting up one dollar a bushel in London as the standard of this inquiry, I had no thought that our farmers could be made happy for the next thirty years by any hope of securing so high a price. In my predictions in 1880 I said that the time was not then far off when the farmers of the Mississippi Valley would secure as large a remuneration from their wheat at thirty-four shillings per quarter in London as they had been gaining from a previous average of fifty-two shillings. I might then have fixed the lessened price at twenty-eight shillings, and at the present time I have a greater expectation of a reduction in the price of wheat in Mark Lane to less than twenty-eight shillings a quarter, or eighty-five cents a bushel, than I had in 1880 that it would so soon reach thirty-four shillings. I merely adopted a dollar a bushel as an arbitrary standard on which an abundant supply of bread at low cost would be absolutely assured to the people of England.

In fact, as I stated before the Royal Commission on Depression of Agriculture, it is not probable that a reduction in the price of wheat to forty cents a bushel on Western farms or sixty-five to seventy cents a bushel in England would stop the growth of this grain, although it might check an increase. When the price went down to a very low point on the last excessive crop it is probable that 100,000,000 bushels of wheat were fed to swine and to cattle. It proved to make better pork and beef than maize or Indian corn, and, as the price of meat did not decline in anything like the proportion to the price of wheat, the farmers who thus fed their excess secured a profit which the sale of the crude grain might not have given.

In this comment Mr. Powers deals with the reduction in the number of foreclosures in Minnesota. Attention should be called to the fact that the United States census investigation for which a million dollars was appropriated, for the purpose of recording farm mortgages in 1890, disclosed the fact that in the ten great grain-growing States of the middle West two thirds of the farms were then free of any mortgage of any kind, and were well stocked; the incumbrance on the remaining third being less than forty per cent of the computed value of the mortgaged farms. Since that date several State investigations have been made, leading to the conclusion that not exceeding twenty per cent of the farms in these States are now under any incumbrance of any kind. In the more prosperous parts of Minnesota and other wheat sections since the substitution of intelligent and varied agriculture for the single wheat crop, foreclosures have almost ceased, such as do occur being attributed to special causes; while such is the abundance of capital accumulated in this section that the rates of interest on safe investments, which but a few years since were nearly double those prevailing in the seaboard commercial cities, are now about even. When certain causes lately produced a short stringency in the money markets of the East, remittances were made from these Western cities for investment in Eastern commercial paper.

In regard to wheat production at a fixed price in London, the Commissioner of Agriculture and Labor of North Dakota remarks: "Wheat at one dollar per bushel in London would net the North Dakota farmer on the average about seventy-five cents per bushel on the railroad track. At that price as a standard, every farmer in the State would utilize all the land he has, and buy up more of the land now lying idle and in the hands of speculators. It would increase immigration so that nearly all the vacant Government land would be taken up. We also have over one million acres of school and State land, of which at least eighty per cent is suitable for raising wheat. Such a price would give North Dakota a boom that never had its equal."

A few words may be given to the report from Texas. The Secretary of the Board of Agriculture states that "the area of arable land of fair quality, including pasture that might be put under the plow in this State, is two hundred thousand square miles; about one hundred thousand square miles suitable for wheat and other grains lying north of parallel 31°; about one hundred thousand square miles lying south of that line adapted to cotton, sugar, fruits, and vegetables of all kinds."

An unexpected reply comes from Idaho, as yet insignificant in wheat production, stating that the potential of that State under the conditions named might reach 400,000,000 bushels.

Again, from Arkansas, to which State we have looked more for excellent cotton than for grain, "there are fifteen million acres of good wheat land; wheat is fast becoming a cash crop, displacing cotton—the capacity of a considerable part of the land at the beginning being forty bushels to the acre, which, being much better than five-cent cotton, is leading the farmers to take advantage of existing prices."

Time has not sufficed since my questions were sent out for replies to reach me from Oregon, Washington, and Montana, where the potential in wheat production is probably equal to that of Minnesota, North and South Dakota combined.

Sir William Crookes makes reference to the future necessity of providing fertilizers, a matter to which the closest attention is now being given by the cultivation of renovating crops. But regard must be given to the fact that we have the most complete and adequate supply of phosphate of lime and phosphate of potash in the vast deposits of bone or mineral phosphates of Tennessee, Kentucky, and Florida, while again we may look to nitrate of soda as a very inexpensive source of nitrogen, of which the most adequate supply can be assured at very low cost. Known methods are also being applied to saving the enormous waste of nitrogen from our coke ovens and iron furnaces.

I almost feel it right to apologize to Sir William Crookes for the presentation of these facts. My function is that of the practical business man who deals with these economic problems wholly from that point of view, and not from the high standard of a complete mastery of the physical sciences.

As I have stated, I happen to have dealt with this question several times at meetings of the British Association for the Advancement of Science, and in other ways in Great Britain as well as in this country. I deem it of the utmost importance at the present time that the interdependence of the English-speaking people should be brought into view in the mast conspicuous manner. In their relative production and conditions the United Kingdom of Great Britain and Ireland and the United States are the complement of each other. Their mutual relation or interdependence is now being recognized, and it can not be long before many of the legal obstructions to mutual service will be removed. The people of this country are now passing through a stage in their economic education closely corresponding to that through which Great Britain passed between 1840 and 1856 under the wise leadership of Sir Robert Peel, Richard Cobden, and William E. Gladstone. We move more quickly, not only in acts but in ideas, than we did fifty years ago. The revolution of ideas which has followed the revolution of institutions in the Southern States has made the people of this country into one homogeneous nation. A revolution of ideas in regard to the conditions of international commerce will presently bring the English-speaking people of the world into one homogeneous body governed by the same common law, the same common principles of action, and the same policy in the collection of revenue. When thus united, there can be no competition in the commerce of the world on the part of the continental states of Europe under their present burdens—the blood tax of standing armies and navies and the money tax of debts that can never be paid. There have been within a few months two witnesses to the growing influence and power of the English-speaking people when united for the maintenance of commerce and for the conduct of the works of peace, order, and industry: one is the warning of the Chancellor of the Austrian Empire, calling upon the states of middle Europe to unite their forces in order to remain capable of maintaining government by privilege and taxation by force of arms; the other, the recent manifesto of the enlightened ruler of Russia, calling upon the states of continental Europe to disarm, lest they should hereafter be incapable of competition with the English-speaking people of the world when they become bound together by a union of mutual service and by community of interest which without any formal alliance will give to them the chief control in rendering service by the exchange of product for product to all other states and nations, to the mutual benefit of all who are thus joined in the bonds of peace.

On my visit to Russia last year, to meet the leading economists and statisticians of Europe, it was stated to me by well-informed men that a plan had been considered by several continental states in the event of war to change the present international custom by making food products contraband of war, the purpose being to cripple England. To such desperate conditions have some of the European states been brought under the burden of the policy of blood and iron. My comment upon this insane proposal was that I hoped it might become a matter of public discussion, since nothing could so surely and quickly bring about a commercial union of the English-speaking people, to the end that, even if no other alliance were made, their navies might at any moment be combined for the protection of their commerce, and for the total cessation of any interference by war vessels or privateers with their traffic.

The prime motive of this article is to remove from the minds of our English friends many false impressions which I have constantly met in my intercourse even among men who hold important positions, of which the address of Sir William Crookes is but an extreme expression, and to bring into common view a comprehension of the resources of this country and of the mutual dependence of the United Kingdom and the United States in the supply and consumption not only of wheat, but of all the other necessaries of life.

THE RACIAL GEOGRAPHY OF EUROPE.

A SOCIOLOGICAL STUDY.

(Lowell Institute Lectures, 1896.)

By WILLIAM Z. RIPLEY, Ph. D.,
ASSISTANT PROFESSOR OF SOCIOLOGY, MASSACHUSETTS INSTITUTE OF TECHNOLOGY; LECTURER IN ANTHROPO-GEOGRAPHY AT COLUMBIA UNIVERSITY.

SUPPLEMENT.—THE JEWS.*

SOCIAL solidarity, the clearest expression of which to-day is nationality, is the resultant of a multitude of factors. Foremost among these stand unity of language, a common heritage of tradition and belief, and the permanent occupation of a definite territory. The first two are largely psychological in essence. The third, a material circumstance, is necessary rather to insure the stability of the others than for its own sake; although, as we know, attachment to the soil may in itself become a positive factor in patriotism. Two European peoples alone are there which, although landless, have succeeded, notwithstanding, in a maintenance of their social consciousness, almost at the level of nationality. Both Gypsies and Jews are men without a country. Of these, the latter offer perhaps the most remarkable example, for the Gypsies have never disbanded tribally. They still wander about eastern Europe and Asia Minor in organized bands, after the fashion of the nomad peoples of the East. The Jews, on the other hand, have maintained their solidarity in all parts of the earth, even in individual isolation one from another. They wander not gregariously in tribes, often not even in families. Their seed is scattered like the plant spores of which the botanists tell us; which, driven by wind or sea, independently travel thousands of miles before striking root or becoming fecund. True, the Jews bunch wherever possible. This is often a necessity imposed for self-preservation; but in their enforced migrations their associations must change kaleidoscopically from place to place. Not all has been said

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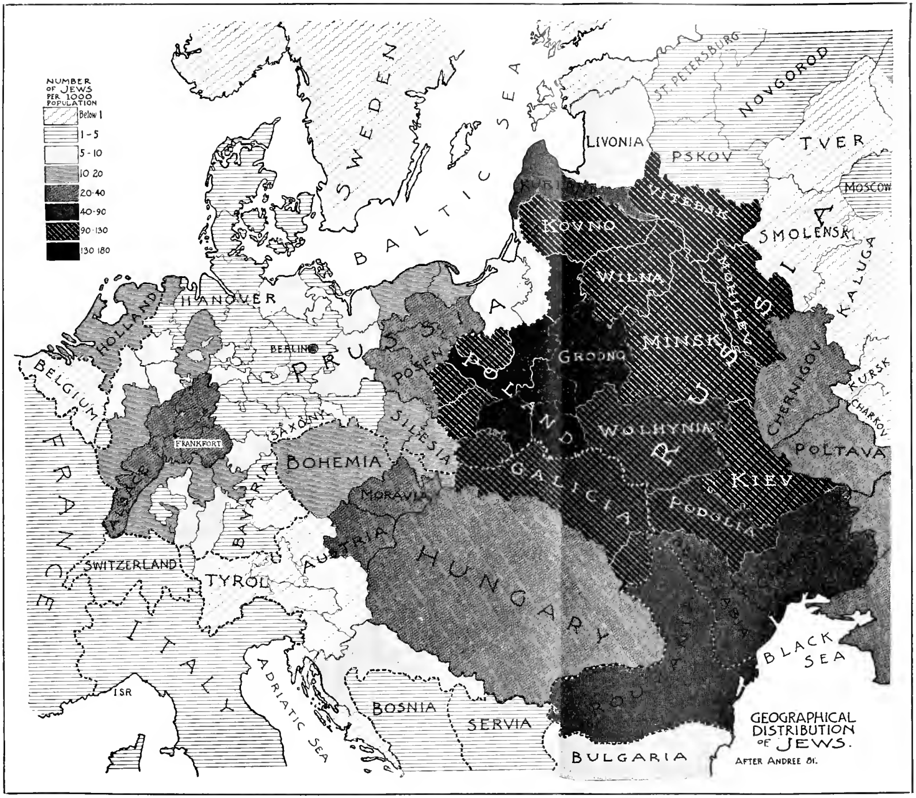
* In the preparation of this article I have to acknowledge the courtesy of Mr. Joseph Jacobs, of London, whose works in this line are accepted as an authority. In its illustration I have derived invaluable assistance from Dr. S. Weissenberg, of Elizabethgrad, Russia, and Dr. L. Bertholon, of Tunis. Both these gentlemen have loaned me a large number of original photographs of types from their respective countries. Dr. Bertholon has also taken several especially for use in this way. The more general works upon which we have relied are: R. Andree, Zur Volkskunde der Juden, Bielefeld, 1881; A. Leroy-Beaulieu, Les Juifs et l'antisémitisme, Paris, 3e éd. 1893; and C. Lombroso, Gli Antisemitismo, Torino, 1894. For all other authorities to whom reference is made by name and year, consult our comprehensive Bibliography of the Anthropology and Ethnology of Europe, in a forthcoming Special Bulletin of the Boston Public Library. In its index under "Jews" and "Semites" will be found an exhaustive list of authorities given chronologically.

even yet of the unique achievement of this landless people. That the Jews have preserved their individuality despite all mutations of environment goes without saying. They have done more. They have accomplished this without absolute unity of language. Forced of necessity to adopt the speech of their immediate neighbors, they have only where congregated in sufficient numbers been able either to preserve or to evolve a distinctive speech. In Spain and the Balkan states they make use of Spanish; in Russia and Poland they speak a corrupt German; and in the interior of Morocco, Arabic. Nevertheless, despite these discouragements of every kind, they still constitute a distinctive social unit wherever they chance to be.

This social individuality of the Jews is of a peculiar sort. Bereft of linguistic and geographical support, it could not be political. The nineteenth century, says Anatole Leroy-Beaulieu, is the age of nationality; meaning obviously territorial nationality, the product of contiguity, not birth. To this, he says, the Jew is indifferent, typifying still the Oriental tribal idea. As a result he is out of harmony with his environment. An element of dislike of a political nature on the part of the Christian is added to the irreconcilability of religious belief. It has ever been the Aryan *versus* the Semite in religion throughout all history, as Renan has observed; and to-day it has also become the people *versus* the nation, as well as the Jew *versus* the Christian. Granted that this political dissonance is largely the fault of the Gentile, its existence must be acknowledged, nevertheless.

How has this remarkable result been achieved? How, bereft of two out of three of the essentials of nationality, has the Jew been enabled to perpetuate his social consciousness? Is the superior force of religion, perhaps abnormally developed, alone able to account for it all? Is it a case of compensatory development, analogous in the body to a loss of eyesight remedied through greater delicacy of finger touch? Or is there some hidden, some unsuspected factor, which has contributed to this result? We have elsewhere shown that a fourth element of social solidarity is sometimes, though rarely, found, in a community of physical descent. That, in other words, to the cementing bonds of speech, tradition, belief, and contiguity, is added the element of physical brotherhood—that is to say, of race. Can it be that herein is a partial explanation of the social individuality of the Jewish people? It is a question for the scientist alone. Race, as we constantly maintain, despite the abuses of the word, really is to be measured only by physical characteristics. The task before us is to apply the criteria of anthropological science, therefore, to the problems of Jewish derivation and descent. Only incidentally and as matters of contributory interest shall we consider the views of



GEOGRAPHICAL DISTRIBUTION OF JEWS.
AFTER ANDREE 81.

the linguists, the archæologists, and the students of religious traditions. Our testimony is derived from facts of shape of head, color of hair and eye, of stature, and the like. These alone are the data indicative of racial descent. To these the geographer may add the probabilities derived from present distribution in Europe. No more do we need to settle the primary racial facts. Further speculations concerning matters rather than men belong to the historian and the philologist.

The number and geographical distribution of the chosen people of Israel is of great significance in its bearing upon the question of their origin.* While, owing to their fluid ubiquitousness, it is exceedingly difficult to enumerate them exactly, probability indicates that there are to-day, the world over, between eight and nine million Jews. Of these, six or seven million are inhabitants of Europe, the remainder being sparsely scattered over the whole earth, from one end to the other.

Their distribution in Europe, as our map opposite shows, is exceedingly uneven. Fully one half of these descendants of Jacob reside in Russia, there being four or five million Jews in that country alone. Austria-Hungary stands next in order, with two million odd souls. After these two there is a wide gap. No other European country is comparable with them except it be Germany and Roumania with their six or seven hundred thousand each. The British Isles contain relatively few, possibly one hundred thousand, these being principally in London. They are very rare in Scotland and Ireland—only a thousand or fifteen hundred apiece. Holland contains also about a hundred thousand, half of them in the celebrated Ghetto at Amsterdam. Then follow France with eighty thousand more or less, and Italy with perhaps two thirds as many. From Scandinavia they have always been rigidly excluded, from Sweden till the beginning and from Norway until nearly the middle of this century. Spain, although we hear much of the Spanish Jew, contains practically no indigenous Israelites. It is estimated that there were once about a million there settled, but the persecutions of the fifteenth century drove them forth all over Europe, largely to the Balkan states and Africa. There are a good many along these Mediterranean shores of Africa, principally in Morocco and Tripoli.

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* Andree, 1881, pp. 194 *et seq*, with tables appended; Jacobs, 1886 a, p. 24; and quite recently A. Leroy-Beaulieu, 1893, chapter i, are best on this. Tschubinsky, 1877, gives much detail at first hand on western Russia. In the Seventeenth Annual Report of the Anglo-Jewish Association, London, 1888, is a convenient census, together with a map of distribution for Europe. On America, no official data of any kind exist. The censuses have never attempted an enumeration of the Jews. Schimmer's results from the census of 1880 in Austria-Hungary are given in Statistische Monatsschrift, vii, p. 489 *et seq.*

The number decreases as we approach Egypt and Palestine, the ancient center of Jewish dispersion. As to America, it is estimated, although we know nothing certainly, that there are about a half million Jews scattered through our cities in the United States. New York city, according to the last census, contained about eighty thousand Poles and Russians, most of whom, it may be assumed, were Jews. But they have come since in ever-increasing numbers, with the great exodus from Russia, at the rate of scores of thousands annually. A recent writer places their present number in New York city at a quarter of a million. The British provinces, on the other hand, do not seem to offer great attractions; as late as 1870, for example, the census in Nova Scotia could not discover a solitary Jew.

A more suggestive index of the problems of Jewish distribution, however, is offered in the ratio of the number of Jews to the entire population. This is directly illustrated by our map. To be sure, this represents the situation twenty years ago, but no great change in relativity is to be suspected since that time. Even the wholesale exodus from Russia of recent years has not yet drawn off any large proportion of its vast body of population. Inspection of our map shows that the relative frequency of Jews increases in proportion to the progressive darkening of the tints. This brings out with startling clearness the reason for the recent anti-Semitic uprisings in both Russia, Austria, and the German Empire. A specific "center of gravity" of the Jewish people, as Leroy-Beaulieu puts it, is at once indicated in western Russia. The highest proportion, fifteen per cent, more or less, appears, moreover, to be entirely restricted to the Polish provinces, with the sole exception of the government of Grodno. About this core lies a second zone, including the other west Russian governments, as well as the province of Galicia in the Austro-Hungarian Empire. Germany, as it appears, is sharply divided from its eastern neighbors, all along the political frontier. Not even its former Polish territory, Posen, is to-day relatively thickly settled with Jews. Hostile legislation it is, beyond a doubt, which so rigidly holds back the Jew from immigration along this line. *Anti-Semitismus* is not, therefore, to-day to any great extent an uprising against an existing evil; rather does it appear to be a protest against a future possibility. Germany shudders at the dark and threatening cloud of population of the most ignorant and wretched description which overhangs her eastern frontier. Berlin must not, they say, be allowed to become a new Jerusalem for the horde of Russian exiles. That also is our American problem. This great Polish swamp of miserable human beings, terrific in its proportions, threatens to drain itself off into our country as well, unless we restrict its ingress. As along the German frontier, so also toward the east, it is curious to note how rapidly the percentage of Jews decreases as we pass over into Great Russia. The governments of St. Petersburg, Novgorod, and Moscow have no greater Jewish contingent of population than has France or Italy; their Jewish problem is far less difficult than that of our own country is bound to be in the future. This clearly defined eastern boundary of *Judenthum* is also the product of prohibitive legislation. The Jews are by law confined within certain provinces. A rigid law of settlement, intended to circumscribe their area of density closely, yields only to the persuasion of bribery. Not Russia, then, but southwestern Russia alone, is deeply concerned over the actual presence of this alien population. And it is the Jewish element in this small section of the country which constitutes such an industrial and social menace to the neighboring empires of Germany and Austria. In the latter country the Jews seem to be increasing in numbers almost four times as rapidly as the native population. The more elastic boundaries of Jewish density on the southeast, on the other hand, are indicative of the legislative tolerance which the Israelites there enjoy. Wherever the bars are lowered, there does this migratory human element at once expand.

The peculiar problems of Jewish distribution are only half realized until it is understood that, always and everywhere, the Israelites constitute pre-eminently the town populations.* They are not widely disseminated among the agricultural districts, but congregate in the commercial centers. It is an unalterable characteristic of this peculiar people. The Jew betrays an inherent dislike for hard manual or outdoor labor, as for physical exercise or exertion in any form. He prefers to live by brain, not brawn. Leroy-Beaulieu seems to consider this as an acquired characteristic due to mediæval prohibition of land ownership or to confinement within the Ghetto. To us it appears to be too constant a trait the world over to justify such a hypothesis. Fully to appreciate, therefore, what the Jewish question is in Polish Russia, we must always bear this fact in mind. The result is that in many parts of Poland the Jews form an actual majority of the population in the towns. This is the danger for Germany also. Thus it is Berlin, not Prussia at large, which is threatened with an overload of Jews from the country on the east. This aggregation in urban centers becomes the more marked as the relative frequency for the whole country lessens. Thus in Saxony, which, being industrial, is not a favorite Jewish center, four fifths of all the Jewish residents are found in Dresden and Leipsic alone.† This is probably also the reason for the lessened frequency of Jews

* This is clearly shown by Schimmer in Statistische Monatsschrift, vii, pp. 489 *et seq.*

† See also map in Kettler, 1880.

all through the Alpine highlands, especially in the Tyrol. These districts are so essentially agricultural that few footholds for the Jew are to be found.

A small secondary center of Jewish aggregation appears upon our map to be manifested about Frankfort. It has a peculiar significance. The Hebrew settlers in the Rhenish cities date from the third century at least, having come there over the early trade routes from the Mediterranean. Germany being divided politically, and Russia interdicting them from 1110, a specific center was established, especially in Franconia, Frankfort being the focus of attraction. Then came the fearful persecutions all over Europe, attendant upon the religious fervor of the Crusades. The Polish kings, desiring to encourage the growth of their city populations, offered the rights of citizenship to all who would come, and an exodus in mass took place. They seem to have been welcomed, till the proportions of the movement became so great as to excite alarm. Its results appear upon our map. Thus we know that many of the Jews of Poland came to Russia as a troublesome legacy on the division of that kingdom. At the end of the sixteenth century but three German cities remained open to them—namely, Frankfort, Worms, and Furth.* Yet it was obviously impossible to uproot them entirely. To their persistence in this part of Germany is probably due the small secondary center of Jewish distribution, which we have mentioned, indicated by the darker tint about Frankfort, and including Alsace-Lorraine. Here is a relative frequency, not even exceeded by Posen, although we generally conceive of this former Polish province as especially saturated with Jews. It is the only vestige remaining to indicate what was at one time the main focus of Jewish population in Europe. It affords us a striking example of what legislation may accomplish ethnically, when supplemented, or rather aggravated, by religious and economic motives.

Does it accord with geographical probability to derive our large dark area of present Jewish aggregation entirely from the small secondary one about Frankfort, which, as we have just said, is the relic of a mediæval center of gravity? The question is a crucial one for the alleged purity of the Russian Jew; for the longer his migrations over the face of the map, the greater his chance of ethnic intermixture. A moot point among Jewish scholars is, as to the extent of this exodus from Germany into Poland. Bershadski has done much to show its real proportions in history. Talko-Hryncewicz † and Weissenberg, ‡ among anthropologists, seem to be inclined to derive this great body of Polish Jews from Palestine by way

* J. C. Majer (1862) ascribes the shortness of stature in Furth to this Jewish influence.

† 1892. ‡ 1895, p. 577.

of the Rhone-Rhine-Frankfort route. They are, no doubt, partially in the right; but the mere geographer would rather be inclined to side with Jacques.* He doubts whether entirely artificial causes, even mediæval persecutions, would be quite competent for so large a contract. There is certainly some truth in Harkavy's theory, so obly championed by Ikof (1884), that a goodly proportion of these Jews came into Poland by a direct route from the East. Most Jewish scholars had placed their first appearance in southern and eastern Russia, coming around the Black Sea, as early as the eighth century. Ikof, however, finds them in the Caucasus and Armenia one or two centuries before Christ. Then he follows them around, reaching Ruthenia in the tenth and eleventh centuries, arriving in Poland from the twelfth to the fourteenth. The only difficulty with this theory is, of course, that it leaves the language of the Polish Jews out of consideration. This is, in both Poland and Galicia, a corrupted form of German, which in itself would seem to indicate a western origin. On the other hand, the probabilities, judging from our graphic representation, would certainly emphasize the theory of a more general eastern immigration directly from Palestine north of the Black and Caspian Seas. The only remaining mode of accounting for the large center of gravity in Russia is to trace it to widespread conversions, as the historic one of the Khozars. Whichever one of these theories be correct—and there is probability of an equal division of truth among them all—enough has been said to lead us geographically to suspect the alleged purity of descent of the Ashkenazim Jew. Let us apply the tests of physical anthropology.

Stature.—A noted writer, speaking of the sons of Judah, observes: "It is the Ghetto which has produced the Jew and the Jewish race; the Jew is a creation of the European middle ages; he is the artificial product of hostile legislation." This statement is fully authenticated by a peculiarity of the Israelites which is everywhere noticeable. The European Jews are all undersized; not only this, they are more often absolutely stunted. In London they are about three inches shorter than the average for the city. Whether they were always so, as in the days when the Book of Numbers (xiii, 33) described them "as grasshoppers in their own sight," as compared with the Amorites, sons of Anak, we leave an open question. We are certain, however, as to the modern Jew. He betrays a marked constancy in Europe at the bodily height of about five feet four inches (1.63 metre) for adult men. This, according to the data afforded by measurements of our recruits during the civil war, is about the average of American youth between the ages of fifteen and sixteen,

* 1891.

who have still three, almost four, inches more to grow. In Bosnia, for example, where the natives range at about the American level—that is to say, among the very tallest in the world (1.72 metre)—the Jews are nearly three inches and a half shorter on the average.* If we turn to northern Italy, where Lombroso has recently investigated the matter, we apparently find the Jew somewhat better favored by comparison. He is in Turin less than an inch inferior to his Italian neighbors. But why? Not because taller than in the case of Bosnia, for his stature in both places is the same. The difference decreases, not because the Jew in Piedmont is taller, but solely because the north Italians are only of moderate height. So it goes all over Austria and Russia: the diminutiveness is plainly apparent.† There is in all Europe only a single exception to the rule we have cited. Anutchin finds them in Odessa and Riga slightly to exceed the Christians. In order to emphasize this point it will repay us to consider the adopted fatherland of the Jews a bit more in detail.

Our map herewith shows a general average of stature for Poland by districts. This unhappy country appears to be populated by the shortest human beings north of the Alps; it is almost the most stunted in all Europe. The great majority of the districts, as our map shows, are characterized by a population whose adult men scarcely average five feet four inches (1.62 metre) in height. This is more than half a head shorter than the type of the British Isles or northern Germany. What is the meaning of this? Is it entirely the fault of the native Poles? We know that the northern Slavs are all merely mediocre in stature. But this depression is too serious to be accounted for in this way; and further analysis shows that the defect is largely due to the presence of the vast horde of Jews, whose physical peculiarity drags down the average for the entire population.‡ This has been proved directly. Perhaps the deepest pit in this great "misery spot," as we have termed such areas of dwarfed population elsewhere, is in the capital city of Warsaw, where Elkind found the average stature of two hundred male Jews to be less than five feet three inches and a half (1.61 metre).# The women were only four feet eleven inches tall on the average. Compare the little series of maps given on pages 172 and 173 if further proof of this national peculiarity be needed. Two of these, it will be observed, give

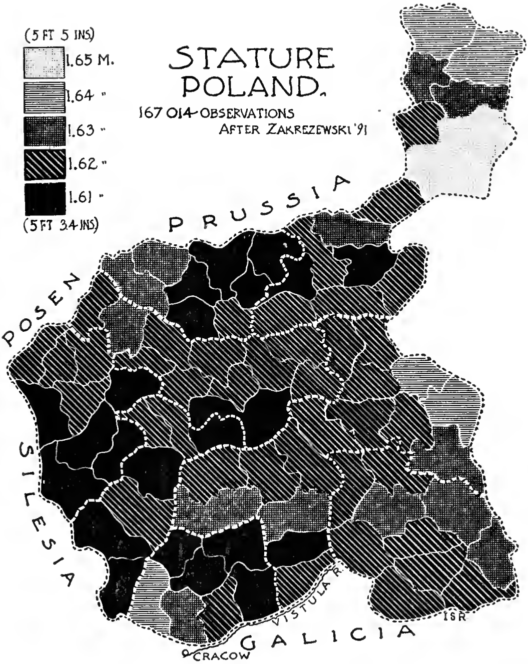
* Glück, 1896; and Weisbach, 1877 and 1895 a.

† Majer and Kopernicki, 1877, p. 36, for Ruthenia; Stieda, 1883, p. 70; Anutchin, 1889, p. 114, etc.

‡ Zakrezewski, 1891, p. 38. In the October Monthly our stature map of all Russia brings out the contrast very strongly.

Centralblatt für Anthropologie, iii, p. 66. Uke, cited by Andree, 1881, p. 32, agrees.

the average height of Jews and Poles respectively, dividing the city into districts. The social status of these districts is shown upon our third map. Comparison of these three brings out a very interesting sociological fact, to which we have already called attention in our earlier papers.* The stature of men depends in a goodly measure upon their environment. In the wards of the city where prosperity resides, the material well-being tends to produce a stature distinctly

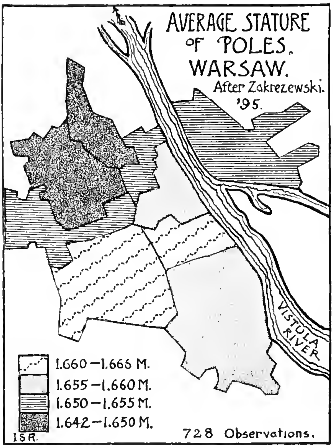


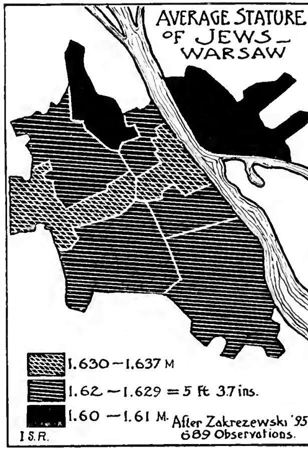
above that of the slums. In both cases, Poles and Jews are shortest in the poorer sections of the city, dark tinted on the maps. The correspondence is not exact, for the number of observations is relatively small; but it indicates beyond a doubt a tendency commonly noticeable in great cities. But to return to our direct comparison of Poles and Jews; the deficiency of the latter, as a people, is perfectly apparent. The most highly favored Jewish population so-

* Popular Science Monthly, vol. li, p. 20 *et seq.* (May, 1897), and vol. lii, p. 602 (March, 1898).

cially, in the whole city of Warsaw in fact, can not produce an average stature equal to that of the very poorest Poles; and this, too, in the most miserable section of the capital city of one of the most stunted countries in Europe.

We may assume it as proved, therefore, that the Jew is to-day a very defective type in stature. He seems to be susceptible to favorable influences, however; for in London, the West End prosperous





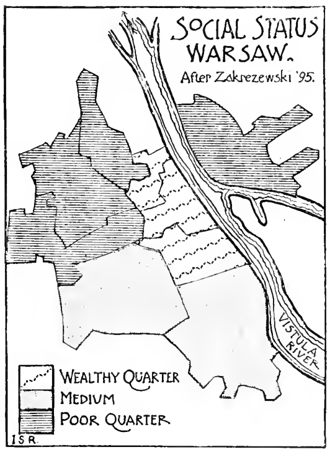
Jews almost equal the English in height, while they at the same time surpass their East End brethren by more than three inches.* In Russia also they become taller as a class wherever the life conditions become less rigorously oppressive. They are taller in the fertile Ukraine than in sterile Lithuania; they sometimes boast of a few relatively tall men.† These facts all go to show that the Jew is short, not by heredity, but by force of circumstances; and that where he is given an even chance, he speedily recovers a part at least of the ground lost during many ages of social persecution. Jacobs mentions an interesting fact in this connection about his upper-class English Jews. Close analysis of the data seems to show that, for the present at least, their physical development has been stretched nearly to the upper limit; for even in individual cases the West End Jews of London manifest an inability to surpass the height of five feet nine inches. So many have been blessed by prosperity that the average has nearly reached that of the English; but it is a mean stature of which the very tall form no component part. Thus per-

* Jacobs, 1889, p. 81.

† Talko-Hryncewicz, 1892, pp. 7 and 58.

haps does the influence of heredity obstruct the temporary action of environment.

Whether this short stature of the Jew is a case of an acquired characteristic which has become hereditary, we are content to leave an open question. All we can say is, that the modern Semites in Arabia and Africa are all of goodly size, far above the Jewish average.* This would tend to make us think that the harsh experiences of the past have subtracted several cubits from the stature of the people of Israel. In self-defense it must be said that the Christian is not entirely to blame for the physical disability. It is largely to be ascribed to the custom of early marriages among them. This has probably been an efficient cause of their present degeneracy in Russia, where Tschubinsky describes its alarming prevalence. Leroy-Beaulieu says that it is not at all uncommon to find the combined age of husband and wife, or even of father and mother, to be under thirty years. The Shadchan, or marriage broker, has undoubtedly been an enemy to the Jewish people within their own lines. In the United States, where they are, on the other hand, on the up grade socially, there are indications that this age of marriage is being postponed, perhaps even unduly.†



A second indication in the case of the Jew of uncommonly hard usage in the past remains to be mentioned. These people are, anthropologically as well as proverbially, narrow-chested and deficient in lung capacity. Normally the chest girth of a well-developed man ought to equal or exceed one half his stature, yet in the case of the Jews as a class this is almost never the case. Majer and Kopernicki ‡ first established this in the case of the Galician Jews. Stieda# gives additional testimony to the same effect. Jacobs ‖ shows the English Jews distinctly inferior to Christians in lung capacity, which is generally an indication of vitality. In

* Collignon, 1887 a, pp. 211 and 326; and Bertholon, 1892, p. 41.

† Jacobs, 1891, p. 50, shows it to be less common in other parts of Europe. In the United States, Dr. Billings finds the marriage rate to be only 7.4 per 1,000—about one third that of the Northeastern States. ‡ 1877, p. 59. # 1883, p. 71. ‖ 1889, p. 84.

Bosnia, Glück * again refers to it as characteristic. Granted, with Weissenberg,† that it is an acquired characteristic, the effect of long-continued subjection to unfavorable sanitary and social environment, it has none the less become a hereditary trait; for not even the perhaps relatively recent prosperity of Jacobs's West End Jews has sufficed to bring them up to the level of their English brethren in capacity of the lungs.

At this point a surprising fact confronts us. Despite the appearances of physical degeneracy which we have noted, the Jew betrays an absolutely unprecedented tenacity of life. It far exceeds, especially in the United States, that of any other known people.‡ This we may illustrate by the following example: Suppose two groups of one hundred infants each, one Jewish, one of average American parentage (Massachusetts), to be born on the same day. In spite of all the disparity of social conditions in favor of the latter, the chances, determined by statistical means, are that one half of the Americans will die within forty-seven years; while the first half of the Jews will not succumb to disease or accident before the expiration of seventy-one years. The death rate is really but little over half that of the average American population. This holds good in infancy as in middle age. Lombroso has put it in another way. Of one thousand Jews born, two hundred and seventeen die before the age of seven years; while four hundred and fifty-three Christians —more than twice as many—are likely to die within the same period. This remarkable tenacity of life is well illustrated by the following table from a most suggestive article by Hoffmann.# We can not forbear from reproducing it in this place.

Death Rates per 1,000 Population in the Seventh, Tenth, and Thirteenth Wards of New York City, 1890, by Place of Birth.

Ages.	Total.	United States (includes colored).	Ireland.	Germany.	Russia and Poland (mostly Jews)
Total	26.25	45.18	36.04	22.14	16.71
Under 15 years	41.28	62.25	40.71	30.38	32.31
15 to 25 years	7.55	9.43	15.15	7.14	2.53
25 to 65 years	21.64	25.92	39.51	21.20	7.99
65 and under	104.72	105.96	120.92	88.51	84.51

From this table it appears, despite the extreme poverty of the Russian and Polish Jews in the most densely crowded portions

* 1896, p. 591. † 1895, p. 374.

‡ On Jewish demography, consult the special appendix in Lombroso, 1874; Andree, 1881, p. 70; Jacobs, 1891, p. 49. Dr. Billings, in Eleventh United States Census, 1890, Bulletin No. 19, gives data for our country. On pathology, see Buschan, 1895.

\# The Jew as a Life Risk. The Spectator (an actuarial journal) 1895, pp. 222–224, and 233, 234). Lagneau, 1861, p. 411, speaks of a viability in Algeria even lower than that of the natives.

of New York; despite the unsanitary tenements, the overcrowding, the long hours in sweat shops; that nevertheless, a viability is manifested which is simply unprecedented. Tailoring is one of the most deadly occupations known; the Jews of New York are principally engaged in this employment; and yet they contrive to live nearly twice as long on the average as their neighbors, even those engaged in the outdoor occupations.

Is this tenacity of life despite every possible antagonistic influence, an ethnic trait; or is it a result of peculiar customs and habits of life? There is much which points to the latter conclusion as the correct one. For example, analysis of the causes of mortality shows an abnormally small proportion of deaths from consumption and pneumonia, the dread diseases which, as we know, are responsible for the largest proportion of deaths in our American population. This immunity can best be ascribed to the excellent system of meat inspection prescribed by the Mosaic laws. It is certainly not a result of physical development, as we have just seen. Hoffmann cites authority showing that in London often as much as a third of the meats offered for sale are rejected as unfit for consumption by Jews. Is not this a cogent argument in favor of a more rigid enforcement of our laws providing for the food inspection of the poor?

A second cause conducive to longevity is the sobriety of the Jew, and his disinclination toward excessive indulgence in alcoholic liquors. Drunkenness among Jews is very rare. Temperate habits, a frugal diet, with a very moderate use of spirits, render the proportion of Bright's disease and affections of the liver comparatively very small. In the infectious diseases, on the other hand, diphtheria and the fevers, no such immunity is betrayed. The long-current opinion that the Jews were immune from cholera and the other pestilences of the middle ages is not to-day accepted. A third notable reason for this low death rate is also, as Hoffmann observes, the nature of the employment customary among Jews, which renders the proportion of deaths from accidental causes exceedingly small. In conclusion, it may be said that these people are prone to nervous and mental disorders; insanity, in fact, is fearfully prevalent among them. Lombroso asserts it to be four times as frequent among Italian Jews as among Christians. This may possibly be a result of close inbreeding in a country like Italy, where the Jewish communities are small. It does not, however, seem to lead to suicide, for this is extraordinarily rare among Jews, either from cowardice, as Lombroso suggests; or more probably for the reason cited by Morselli—namely, the greater force of religion and other steadying moral factors.

[*To be continued.*]

THE PLAYGROUNDS OF RURAL AND SUBURBAN SCHOOLS.

By ISABELLA G. OAKLEY.

WHILE the officers and friends of education in large cities are exerting themselves to provide open-air playgrounds for the schools, the villages and smaller towns all over the East are reversing the case. Except in the small district schools, the children's playground has almost ceased to exist.

This is an evil which has crept in with the tendency to centralize the schools. When in any place the schools begin to overflow, a movement to put up a larger building takes place, accompanied by an effort to create a high-school department; not so much the need of the community as the ambitious dream of some principal who would be superintendent, or some sort of central sun to a group of satellites. This dream is too easily realized, because it flatters the people. Then there rises a preposterous structure of stone and brick; a house of many gables, out of keeping with everything, either public or private, in the place; a temple of vanity. Now is rung the knell of the school playground, for the new "high school," although it will house all the children from five to fifteen, must needs be surrounded by a fine lawn, studded with shrubbery, and threaded by bluestone roads. The janitor has to employ an assistant to keep the grounds in order. A shut-in, penitentiarylike place has been evolved by the architect and school committee, gratifying to their pride and a deep wrong to the children. There are many wrongs about it; the one insisted upon here is the abolishing of the recess, that time-honored joy of the American schoolboy and schoolgirl.

The cheerful sounds of play no more re-echo; the little ones march in "lock step" from the doors to the very curb of this immaculate ornate inclosure. If, on this beautiful lawn, any impulsive youngster is caught running, or performing an instinctive hopscotch or leapfrog, he is sure to be seen by a watching and powerful janitor and reported. Leapfrog and profanity, in the true Draconian spirit, are alike visited with the extreme penalty of a visit to the principal's office. However, in default of a playground, the new schoolhouse provides a gymnasium for physical culture. I speak now of a particular school, the pride of a simple village, and a type of many. This gymnasium is a costly room filled with elaborate apparatus, most of which is suited only to the high-school pupils, and never touched by the majority, who leave school at twelve or thirteen; their physical exercises have been chiefly provided for by a box of dumb-bells and wands. In many schools the "gymnasium" is a cavernous and ugly basement, a place full of shadows cast by the gloomy arches on which the building rests, with walls of brick and floors of asphalt. Little troops of silent, pale children arrive and depart all day for their *physical culture,* a dreary repetition of silent dumb-bell exercises. There is no speech nor language among them, no sound is heard but the jingle of the piano and the sharp tones of the monitor's counting. I have never heard the children count aloud or accompany the calisthenics by singing except in a private school. What an alternative for a free recess! No penitentiary drill could be more perfunctory, spiritless, dead. It must be said of the public schools that the thing they most seem to dread is the sound of a child's voice. The rude, untrained intonations, the slovenly speech, the slouching attitude remain rude, slovenly, and slouching, for all the school attempts to do for their improvement is infinitely little. Even the blessed relief of shaking the arm and hand to attract the teacher's attention has been reduced in some schools to lifting two fingers.

The pupils generally hate their calisthenics, or, in the new phrase, physical culture exercises. And they would hate just as sincerely regulated games superintended by some impossible master of sports. What they want is spontaneity in play. Public money is wasted in providing these abhorrent alternatives. Poor little Carthusians as young as six and seven years are kept in their rooms, and principally in their seats, above two hours at each session, and often after that to atone for some delinquency, most likely for speaking. In many schools they do not leave the room for any kind of exercise. If they were capable of demanding their rights they would call for both the abolition of the school lawn and calisthenic basement, and the restoration of their playground and recess.

From the cruelty of this repression nature finds a little way out; the children require of the neighbors what they have been deprived of by the school committee. All around the precincts of the temple of learning the trodden borders of the sidewalk, churned to mire in winter and trampled to rock in summer, speak of the victory of the boys. There are towns, perhaps, where they all go straight home, but in our town they gather four times a day in knots of twenties and fifties for some kind of fun. The patient neighbors go on removing coats and dinner pails from the pickets, clearing away papers and missiles from their inclosures, yet I discover that even they would vote to keep the school lawn; it improves the town. Very true. But ingenuity could well contrive some way of uniting the playground and the school park. Spaces of grass to rest the eye and decorate the square could be interspersed with inclosures of asphalt, furnished with a few parallel bars and swings, without sacrifice of appearances. Often the school property is so large that it could include half a dozen such special playgrounds. We have but to begin it to find some feasible plan.

If the palatial school and its park is reaction against the "ragged beggar" of Whittier's lovely poem, sunning in the midst of the blackberry vines of Hardscrabble Hill, it is a reaction that has gone too far to suit a generation which loves to read Hosea Bigelow:

"So the old school'us is a place I choose
Afore all others, ef I want to muse;
I set down where I used to set, an' git
My boyhood back, an' better things with it—
Faith, Hope, an' sunthin', ef it isn't Cherrity,
It's want o' guile, an' thet's ez gret a rarity."

If it may be replied, that is not the generation for whom schoolhouses are now built, it is one which may interpret the wants of its children by just such recollections.

Another evil has grown out of the centralization of the schools. The smaller schoolhouses formerly stood within convenient reach, and by abandoning them we have forced many little children to walk farther than they are able to walk. In the absence of street cars and sidewalks this becomes a great hardship in extreme weather. In one village in New York, out of an enrollment of fourteen hundred, there was one month last year an average attendance of four hundred. The new school building, which had cost seventy-five thousand dollars, was more than two miles from some part of the district, and there were no sidewalks; neither were there paved streets or street lamps. In such circumstances a number of children are unable to get home to the noon meal, usually dinner, and most important. Where do they eat their luncheon? In their seats, watched by teachers, who are compelled unwillingly to take turns at this duty, and who have also to eat a cold, unpalatable lunch in bad air for a week at a time. After lunch there is an hour to be disposed of by the children, but there is no place to play in except the basement or the streets of the neighborhood. The teachers frequently read them a story, that they may stretch their minds a little if not their bodies. It is a painful sight—few more painful to me—to see a crowd of young children having their recreation in one of these basements. Running and loud talking are forbidden; a police of teachers armed with symbols of authority and punishment keep the restless little prisoners within bounds.

Another objection to the central school is the rainy-day half-session. Though the daily instruction may be managed so that the pupils do not miss anything, it is still a fact that the majority of parents expect the school to take charge of their children, and are often much dissatisfied to have them thrown back upon their own hands on rainy days.

How has it come about that the playground and school recess have been so generally given up? Is it altogether on account of appearances? Teachers plead that the children ought to be preserved from association with objectionable playmates. This may do for the touch-me-not, only child, but in American society it is never a strong plea. That small fraction which seeks to educate its children as a class can do so in a few schools limited to church, plutocracy, Quakerism, or some such narrow basis. But the schools of a free State are, above everything, founded on the essential equality of individuals in the State, and the possibility of every one to rise to a successful and honorable manhood. If there is one conviction above another strengthened by experience, it is that, in their choice of companions and susceptibility to influence, children are governed by their innate qualities, and these qualities are fixed by heredity and home influences long before the school age. In so large a community as a public school there is companionship for all, for it certainly represents the town itself. Let no one be afraid of the democratic instincts of childhood.

I believe the playground is abolished because it interferes with that deadly order and craze for supervision which is sought for as the prime condition both inside and outside the schools. Order of a wholesome sort is not inconsistent with the free recess of a big school. I watched in Los Angeles a great school as it was marshaled out to play and back again at the sound of a drum. After a quarter of an hour of unrestrained sport, several hundreds were gathered in lines at the tap of the drum, facing the cheerful schoolhouse in the mild bright sun, their faces radiating contentment and good will while they straightened up at the mere hint of the teachers on duty. In San Francisco I once found a certain primary school keeping doll's day, when every girl brought her doll to school and exhibited her at recess. The school yard was a barren inclosure within a high board fence, but a joyful place to that young company. To what purpose are teachers urged to study psychology? The children in their seats are emptied of everything that pertains to their souls. Not to study, because the teacher will explain everything, and to behave just well enough to get safe out of school, is the simple code which covers the conduct of average children. To extend this code to ideas of social duty—the highest—is not possible while they do not form a society. Cultivation of friendship is just as much out of the case; awakening of ideals, an impossibility. But thrown together half an hour or more each day, the dead machinery that pulls the bells and adds the marks within the school walls gives way to life; and here a man who sympathizes with childhood has all the opportunity he needs, and probably much more than he can use, in providing for that life where a code of reciprocity and honor must be established. It is not as the magistrate he will successfully rule, but as the sympathetic general in the field, whose very name is a talisman and an inspiration to every man. In the school yard, the bully, who comes to the front in about every tenth child, needs to be repressed; the foul mouth must be cleansed; against these prevailing evils the playground has a protection the street can not possess. The boy's world is a peculiar world, certainly, making laws for itself as rigorous and about as barbarous as those of a gang of pirates; but it is through his *esprit du corps* he can be uplifted and educated; the individual may be a selfish animal; as one of a body he is capable of heroism and devotion to a noble idea. He can be a friend; the playground is the field for the natural growth of friendships, and youth the generous time of their birth.

I recall another scene in a schoolroom in a Western city long ago. A gentle girl, magnetic, deep-hearted, large-eyed, sat after school at her table in tears. On a seat in front of her platform were piles of slates which she had been correcting, for she instructed all day a succession of arithmetic classes coming to her from the different grades. At the same time she was in charge, for all particular purposes of their order and conduct, of about forty boys in their early teens. Her tears were in consequence of a quarrel at recess between two of her boys. They had settled their quarrel by a fight; not unlikely it was a wholesome fight, for they were not boys of the mean sort, and were friends. It is an affair of long ago, but of a time when, in a large city, a teacher shed her influence upon the school playground, and took account of its moral standards, its friendships and breaches of friendship.

Although white men, if they take due precautions, may live and do certain kinds of work in tropical Africa, it will never be possible, Mr. J. Scott Keltie concludes from the results of past experience and study, to colonize that part of the world with people from the temperate zone. Even in such favorable situations as Blantyre, a lofty region south of Lake Nyassa, children can not be reared beyond a certain age, but must be sent home to England; otherwise they will degenerate physically and morally. A plan has been proposed of bringing Europeans down into the tropical regions by degrees, and acclimatizing them by successive generations to more and more torrid conditions till they are finally settled in the heart of the continent. But the experiment would be a very long one, if tried; and the ultimate result would probably be a race deprived of all those characteristics which have made Europe what it is.

UP THE SKEENA RIVER TO THE HOME OF THE TSIMSHIANS.*

BY GEORGE A. DORSEY, PH. D.,
FIELD COLUMBIAN MUSEUM, CHICAGO, ILL.

IN a recent number of the Monthly I described some of the incidents of a visit to the Haida and Tlingit villages about Dixon's Entrance; now I am to speak of the Tsimshian villages on the Skeena River. The Tsimshian Indians are one of the five great stocks which make up the aboriginal population of the coast of British Columbia and southern Alaska. They are shut in by the Tlingits on the north and by the Kwakiutls on the south, while on the head waters of the Nass and Skeena Rivers they come in contact with the great Tinneh or Athabascan stock. The Tsimshians are probably the most progressive of all the coast Indians, and are one of a few stocks on the American continent which are holding their own in point of numbers.

Desiring to visit those villages which are least contaminated by modern influence, we ascended the Skeena River to the village of Kitanmaksh or Hazelton. The Skeena is the historic river of British Columbia; its name signifies the "Water of Terrors." Nearly every rock, every bend, every cañon is the scene of some mythical tale. The scene of the birth of the Tsimshian nation lies in its valley; the rock is still revered upon which rested the Tsimshian ark after the flood, and the "Dum-lak-an," "the new home and place of dispersal," is still a Mecca to which pilgrimages are made. In the modern development of the Omenica and Cariboo gold fields the Skeena has been the highway to the sea. For hundreds of years canoes have been paddled up and down its waters; it has been the highway for intertribal trade from time immemorial, and when the Hudson Bay Company's post was established at Hazelton, and merchandise began to pour into the upper country in a steady stream, the Tsimshians with their canoes enjoyed for a long time a monopoly of the carrying trade. Gradually, as they learned the ways and methods of the white man, the price per ton of freight from the coast to Hazelton began steadily to rise, until in 1891 the tariff of sixty dollars a ton was declared ruinous by the company, and they decided to build their own steamer with which to carry their freight up the river.

Port Essington is the chief port of the mouth of the Skeena, and in Essington we found ourselves on the twenty-third day of July. The Caledonia was up the river on her third trip, but was expected back any hour, but so delightfully uncertain is the river

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* From a lecture delivered at the Field Columbian Museum, November 13, 1897.

voyage that, as we were informed, "there was no telling when she would be down—in fact, she might be caught above the cañon and wouldn't be down for weeks."

The town of Essington dates back to 1835, when the Hudson Bay Company established a post there. Its only rival for preeminence on the coast is Port Simpson. The town in summer is completely given over to fishing, the salmon cannery of Cunningham & Son being one of the largest on the coast, and the river for twenty miles is dotted with canneries. In one day, while we were

VIEW ON THE UPPER SKEENA RIVER; PEAK OF THE "FIVE VIRGINS" MOUNTAIN.

in Essington, the catch of salmon on the river was ninety-two thousand fish. In addition to the cannery the town boasts of a good hotel and a Salvation Army. An Indian Salvation Army is worth going miles to see, for the Indian is a natural-born salvationist; the army permits him to make all the noise he chooses, sing as loudly as he pleases, and, best of all, he is entitled to make a speech every time it comes his turn.

In the afternoon, about four o'clock, on the day after our arrival, a long, shrill blast of the whistle aroused the entire town, for the Caledonia was in sight. Down we went to the wharf, and the entire town followed. What a motley crowd you will find on one of these

British Columbia wharves! What coloring, what a Babel of tongues —Tlingits from Alaska, Haidas from the Queen Charlotte Islands, Tsimshians from the Skeena, Kwakiutls from Vancouver, Chinamen, Japanese, Greeks, Scandinavians, Englishmen, and Yankees; men, women, children, dogs, and from two to six woolly bear cubs. The Caledonia is the exclusive property of the Hudson Bay Company; she is not a common carrier, and does not encourage either passengers or freight, as the tariff rates prove. There is a feverish haste and hustle about the movements of the steamer which are fairly contagious. She makes her first trip early in the spring, as soon as the ice has left the rivers, on the Stickene; then it is a wild, eager ambition of the company to have her make four trips up the Skeena before the river closes up in the fall.

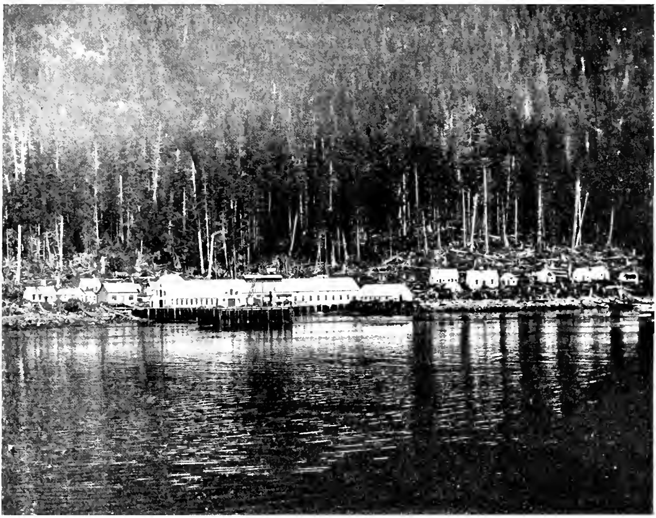
We had as passengers two prospectors from Spokane, a mining expert from Victoria, a native evangelist from Essington, and about fifty Indians, mostly women and children, each one with a varied assortment of boxes, bales, bundles, and dogs; the crew numbered twenty, and we had about one hundred tons of freight on board.

From Essington to Hazelton is one hundred and fifty-two miles, a panorama of unending and unbroken beauty; never monotonous, always interesting, it presents a river voyage which is probably not equaled, certainly not excelled, by any other river voyage of the same length on the American continent or in the world. We began the voyage on Sunday morning, we tied up in front of Hazelton on Saturday night. To recount in detail the haps and mishaps of each day's progress would take more time than I can command. In one day we made forty-eight miles, on another day we made one hundred yards, on another day we didn't make a foot. With plenty of water under her keel the Caledonia could run twenty miles an hour; she could cut her way through a sand bar at the rate of a yard or so an hour; and at either rate of progress she burned each hour from one and a half to two cords of wood.

For the first ten miles the scenery does not differ materially from that which we are accustomed to in the inland sea from Victoria to Alaska. Then we enter fresh water and for the next forty miles steam through one long mountain gorge, for here the river has cut completely through the Cascade Range. The mountains begin at the water's edge and rise almost perpendicularly to heights of from three to four thousand feet. Their lower limits are covered with dense green forests, which seem to grow out of the solid rock. The summits are smooth and glistening, and often covered with snow and ice. Here and there we can trace some tiny rivulet issuing from an ice bed high up among the clouds, and every portion of its course can be traced down the steep mountain wall until it gives one final and headlong plunge into the river. At times these streams, taking their rise in some extensive glacier, are of considerable magnitude, and fairly roar as they leap and hurl themselves downward from their dizzy height. And here we learned a curious fact about the river: in summer it falls when it rains, and rises when the sun shines, so rapidly do the pent-up snows of winter disappear and rush down the mountain sides under the heat of the spring sun.

Until noon of the second day we had been making good time, but now the fun began, for we had left deep water and had arrived at the first flight of the eight-hundred-foot stairway which the Caledonia had to climb ere Hazelton could be reached. The river had been gradually widening as one island after another had been passed, until now it was nearly half a mile wide and flowed through four channels. The captain attempted one channel, but we couldn't gain an inch, and in drifting back again down the rapids the current carried the boat against the rocks and, with a crash and a lurch, but minus some woodwork, she was in the stream again. Then two other channels were tried, but without avail, although the wheel was throwing water and gravel over the pilot house. The fourth channel was next tried, but the current was too strong. Then we "lined her out," and this novel method of getting a huge steamboat up a stream soon became only too commonplace. The method of procedure is this: The boat is forced against a sand bar and allowed to rest while men go forward in a skiff with a long four-inch cable, which is made fast to a tree on the bank or to a "dead man," a long spar buried deep in the earth of a sand bar and heaped over with bowlders. When all is ready, the boat is attached to the capstan and the wheel begins to revolve. It is tedious work and often provoking, as when the cable parts, or the "dead man" gives up his hold, and the whole work must be done over again. The boat quivers from stem to stern, and the wheel, with all possible steam on, is simply one revolving ball of water. We fairly hold our breath as we listen to the dull vibration of the boat, the rumbling of the capstan, and the grating sound of the keel of the steamer as she is being dragged through the rapids over the bar; but above all can be heard the voice of Captain Bonser as he shouts to his Indian pilot, "Go 'head capstan," "Stop steamboat," "Stop capstan," "Go 'head steamboat," "Go 'head capstan!" In four hours we have made about fifty yards, but we are in open water again and the boat settles down to its regular chug, chug, chug.

Eighty miles from Essington the Skeena in its flight to the sea makes its first plunge into the Cascade Mountains, and its entrance is indescribably grand. No pen or brush can do justice to the beauties of the Kitselas Cañon. At its mouth we are in a broad, deep basin, as if the river had felt depressed as it passed through the quarter-mile narrow gorge and had here spread itself out to breathe and rest before it started anew its downward journey to the sea. It was late in the afternoon, and the western sun threw long shadows of the lofty sky-crowned perpendicular walls of the left-hand side of the cañon over against the rocky islets and ragged, rock-bound eastern shore. Once we have entered, there is no faltering; "lining it out" is impossible here, and on and on the boat labors



A Skeena River Salmon Cannery.

and climbs, twisting and turning through the narrow, tortuous channel. A quick eye and a steady nerve must command the wheel now, for a turn too much or too little would be fatal. One instinctively feels that the "Water of Terrors" is the proper name for this river, and with that feeling comes the other—that it was never intended for navigation.

After four days' grinding over sand bars and pounding against rocks we tie up for repairs. One of the boilers had sprung a leak which could be neglected no longer. The delay of thirty-six hours was not without compensation, for the country about was open, and proved a relief after the long ride through the high-walled river from the sea to the cañon. The banks were low or moderately high and of gravel or sand bluffs, and we could look off over a landscape broken here and there by solitary peaks or clustered mountains, their summits always covered with ice and snow. To the far east were the pure white peaks of the Five Virgins, their summits glistening under the bright sun. Even the character of the vegetation had changed, and the dense forests of somber firs, spruces, and cedars of the lower river had given way to great cottonwoods and underbrush of hazel and alder.

In the afternoon we climbed a bluff near the river, from which we could look off over a country that was wild and extremely picturesque. To one side of us could be seen a great mountain, its summit covered by a mighty glacier whose blue-white ice gleamed and glistened in the sun. And there was no mistaking the power of the sun that day; its warm rays being especially welcome after some weeks of the cold, depressing gloom and fog of the coast.

We were now really in the country of the Tsimshians, and every few hours we drew up in front of some quiet, peaceful village, its almost deserted cottages guarded by the totem poles of former days. In succession we pass Meamskinesht, Kitwangah, and Kitzegukla, with now and then a small salmon-fishing station. The villages proved disappointing both in their smallness and modernness, and none of them seemed worthy of any extended visit. From time to time we passed great black patches in the forest, the result of extensive fires, sure signs that the rainy coast was far away.

On Friday night we tied up to the bank within five miles of our destination, but we had yet to pass Macintosh's Bar. That was accomplished on the following day, after eleven hours' hard work, and by five o'clock we had reached "The Forks," or the junction of the Skeena and Bulkley Rivers. Our course was to the left, up the Skeena for half a mile, and in a few moments more we tied up in front of the stockaded post of the Hudson Bay Company; we had reached Hazelton. The region about us was "Dum-lak-an," "what will be a good place," the home of the Tsimshians.

Before 1870 the town was farther down the river, on the flat at the junction of the Bulkley and Skeena Rivers. It has had additions to its population from Kis-pi-yeoux, and from villages down the river. There are also to be numbered among the inhabitants the Indian agent, Mr. Loring, the Hudson Bay representative, Mr. Sargent, and his assistants, and Mr. Fields, the missionary. The Indian population numbers about two hundred and seventy-five. The town occupies a low, uneven plain, which, beginning at the water's edge, extends back for a quarter of a mile, where it is hemmed in by a high bluff on the face of the second river terrace. There are but few of the old houses left and still fewer totem poles, and they are without particular interest. Most prominent in the village is the warlike stockade of the company's post, with its two bastions at opposite corners, and the blockhouse in the center of the inclosure, but now hidden by the store which stands in front of it. The stockade was put up in 1891, when an Indian uprising was feared throughout the length of the river.

Wherever you find a trading post and a missionary you can not hope to find people who retain much of their native life or who are of great value to anthropology. But still Hazelton was sufficiently primitive to be of interest in many respects. In matters of dress the Indians are almost on a footing with the whites, but they still make a curious garment for winter's use which is worn by nearly all of the interior tribes. This is a blanket made out of long, narrow strips of rabbit hide, and is warm, heavy, and extremely durable. We were fortunate enough to find a woman who was engaged in

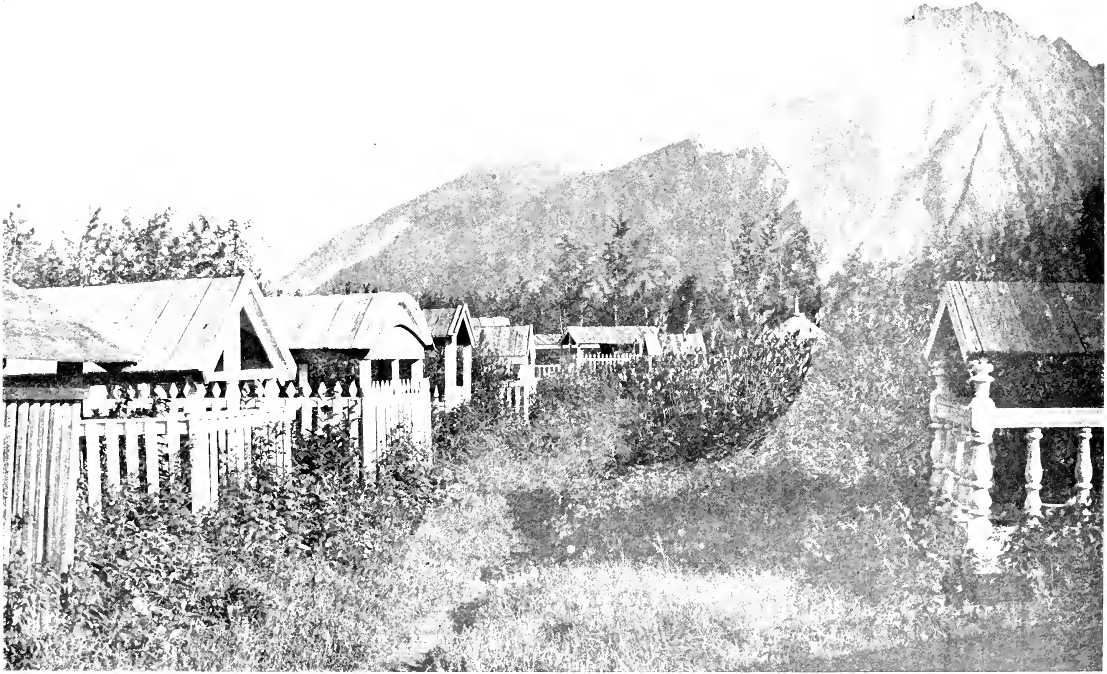
TSIMSHIAN SHAMAN'S CEREMONIAL BOW AND ARROW.

making one of these curious garments on a most rude and primitive loom. Other garments are still occasionally made of Indian hemp, which grows wild and in abundance. This is beaten and pounded and then spun into fine thread, and woven into the desired form.

In former days the Indians used large quantities of the wool of the mountain sheep in making the beautiful *chilcat* blankets that formed an important part of the chief's costume, but now the Indians buy most of their wool. Its chief uses are for sashes and belts, which are still worn and made after the fashion of former days. Of other garments of daily use, except moccasins, there is nothing remaining. There are a few remnants of ceremonial costumes still in existence, and by a bit of good fortune we were enabled to secure the complete paraphernalia of a shaman, or Indian doctor, who had only recently renounced his native practices and joined Mr. Fields's band of Christians. In the outfit thus acquired were rattles, charms, blankets, masks, and headdresses of various kinds. From another individual we secured the complete costume of a member of the fraternity, or secret society, of Dog Eaters. The Tsimshians have four such societies, and the Dog Eaters stand third in rank, being surpassed only by the Man Eaters or Cannibal Society. The chief object of this outfit, apart from the white and red cedar bark rings, was a long club, one side of which was ornamented by a fringe of red cedar tassels. Of interest also was the curious cap made of plaited bands of red cedar bark, and so ornamented as to represent the head of the owl. Another object secured from a shaman was a peculiar bow and arrow. These were purely ceremonials, and were only used in the dances of the secret societies. By an ingenious device the point of the arrow could be opened out, and in this position represented the open jaws of a serpent. On the bow were two fins, that could be lowered or raised at will by means of cords, which represented the fin-back whale. The bow itself is of light soft wood, and is bent by means of a string passing around the operator's body, the two ends of the bow being fastened to the body of the bow by leather hinges.

In all the ceremonies, both religious and civil, an important part of the costume is the mask. These are generally of wood, and portray all manner of real and fanciful personages. Some of them are wonders of ingenuity, being so constructed that the eyes, mouth, and often the ears can be moved at the will of the wearer. Some of them are even double, and so arranged that by drawing open the outer mask, an inner one of an entirely different character can be revealed. One of the rarest masks which was ever brought out of the Tsimshian country is one in the possession of the museum, which was acquired some time ago. It is of bone and finely carved, while the teeth and tusks are those of animals.

Hazelton is of much interest to the observer of the human countenance, for, while the residents of the town are Tsimshians, there is a village near by on the Bulkley River, the people of which belong to the great Tinneh or Athabascan stock, which extends from the Arctic Circle on the north to the Territories of Arizona and New Mexico on the south, where it is represented by the Apaches. In some respects the differences between the Tsimshians and Tinnehs, or Howgelgaits, as this branch is called, are quite marked, and these differences stand out in greater relief because more or less of the population of Howgelgait spend a part of their time in Hazelton, and so one sees representatives of the two stocks in close contact. The Tsimshians, like the Haidas, are great canoe people, and are rather short-legged, with great development of the chest and shoulders. Like the Haidas, also, they have strong, long arms, which bespeak familiarity with the paddle. The Howgelgaits, on the other hand, are a pure mountaineer people, and are tall, robust, and finely proportioned. Their hair is black, coarse, and abundant. The eyebrows are thick and remarkably wide at the outer side. This same peculiarity may be observed in the masks of this tribe. The beard is sparse, but it must



A Street in the Tsimshian Cemetery at Hazelton, B. C.

be remembered that the hair is generally pulled out as it appears, particularly on the cheeks, while the mustache and the chin tuft are allowed to grow. Among the Tsimshians the face is wide and the cheek bones are prominent. The nose is narrow, with a depressed root. Neither the Tsimshians nor Tinneh practice artificial deformation of the head. With the Tinneh, or more exactly the Howgelgaits, the forehead is broad and less receding than is usual with the American aborigines. The face is full and broad and the cheek bones prominent, but the nose, unlike that of the Tsimshians, is well formed and generally aquiline, although occasionally it is thick and flattish. Their lips are also thick and the chin is more prominent than is usual among the Tsimshians. The eyes are large and of a deep black color; the jaws are generally very heavy and massive.

Of traces of the ancient prevalent fashion in deformity we saw very little. One old woman still retained the labret, but it was only a shadow of the former labrets in size. Although the long, finely polished bone ornament which the men formerly wore in a hole through the septum of the nose has entirely disappeared, we saw a few old men in whom the pierced septum was still plainly visible. With the Howgelgaits it was formerly the custom to load down the ears with highly polished bits of abalone shells, which were suspended by means of brass rings inserted into holes one above the other on the outer margin of the ear, extending from the lobe around the entire helix.

Hazelton's " City of the Dead " stands on a high bluff overlooking the town and valley, and commands a view off over the broken forest-clad country which is as beautiful as well could be. A trail winds along the face of the bluff until the crest of the plateau is reached, where it divides into a right and left path leading through the main street of the silent city. The sight is strangely odd and picturesque. Over each grave has been erected a neat little frame house, often of considerable dimensions. All are painted with bright colors, and the effect is decidedly " mixed." In one of the houses, which was substantially built and neatly carpeted, I saw through a glass window two chairs, a washstand with full assortment of toilet articles, and an umbrella, while at the rear of the house stood a table on which was spread a neat cloth, and on the table was a lamp. On the floor was a new pair of shoes. Over the table hung a large crayon portrait of the departed occupant of the grave beneath.

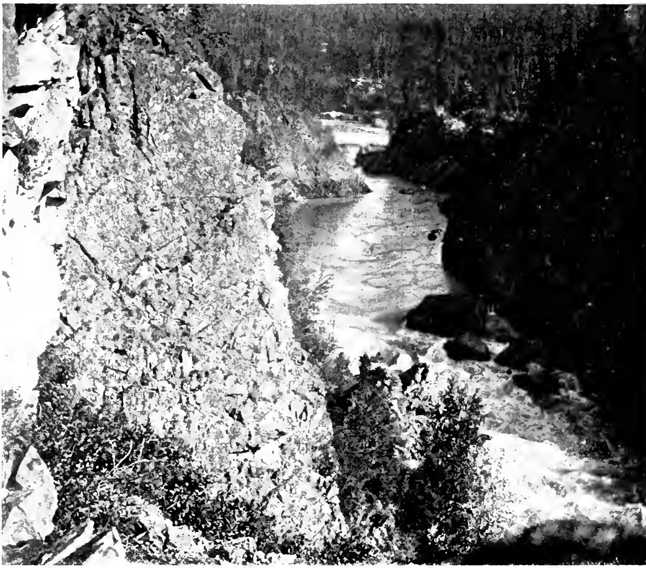
In another house I saw chests of clothing, and suspended from a cord were garments of various kinds, including a complete costume of the fraternity of the Dog Eaters. These five-feet-deep graves covered by little houses are not the usual manner of burial with the Tsimshians, for until within a very few years the dead were cremated. Even to-day in the neighboring village of Kispiyeoux the dead are buried in shallow graves just in front of the house.

Of the many charming spots about Hazelton which are well worthy of a visit, we had time for only one—a horseback ride to the Howgelgait Cañon. The ride was most enjoyable in every respect. The road leads from the town up over the plateau through the burying ground, and then on through a partly cleared forest of cottonwoods and maples. Then we plunge into a two-mile-long lane, the trail scarcely wide enough to admit of the passing of a horse, through a dense grove of hazel bushes, laden to their tips with unripe nuts still protected by their green fuzzy envelopes; and now we knew whence came the name "Hazelton." Suddenly the grove terminates, and after dismounting and walking forward a few steps we came to the face of the cañon. What a sight! On the opposite cliff, but on a higher level, stands the old deserted village of Howgelgait, with its great empty houses and skeleton totem poles. At our feet, down a sheer precipice almost a thousand feet below, the Bulkley River, set on edge, rushes and roars and foams through the rocky gorge to join the Skeena a mile away. Just by the mouth of the cañon, at the edge of the great whirlpool, and on a gravelly beach, stands the present town of Howgelgait. Hearing shouts, we looked closer, and far down we saw men moving about, their forms dwarfed to almost spiderlike dimensions. They were building a swinging bridge over the river, and the timbers already in place looked like the meshes of a spider's web.

Looking up the cañon, we could see from the opposite wall near the water's edge, and far below us, a rude scaffolding suspended by bark ropes over the river, and from this Indians were lowering their nets and drawing up salmon. One man after another would leave for his home, his back bending under the weight of many fish, his place to be taken by another, who begins casting his nets. And so these rude scaffoldings here and all along the rivers are occupied by busy fishermen throughout the summer, for salmon is chief of the winter's food supply of these people. In one house we saw over a thousand salmon hung up to dry for use during the winter months.

We left the cañon for the ride back to Hazelton with keen regret, for no more fascinating spot did we find on our entire journey than right here. On the way we encountered a woman of the Carrier tribe of the Tinnehs from Frazer's Lake, who was returning from Hazelton laden with provisions and cheap calicoes.

We had scarcely entered Hazelton when the tinkling of the bell of the "lead horse" announced the arrival of the pack train. Second only in importance to the arrival of the Caledonia to the people of Hazelton is the arrival of the pack train, for it brings the news of the far interior. But of much greater importance and value is the cargo of furs which are brought out on every trip in exchange for supplies which are taken in. On that day there were fifty-seven mules, each laden with two bales of furs weighing two hundred and fifty pounds, and including beaver, mink, otter, sable, and bear, all destined for the Hudson Bay Company's house in London, there to



HAGIVILGAIT CAÑON, WITH INDIAN FISH WEIRS AT BOTTOM.

be auctioned off in lots to the highest bidder, and then to be distributed to all parts of the civilized world.

Within less than an hour's time the precious furs were aboard, and we bade farewell to Hazelton. The Caledonia drops back, is slowly turned around by the current, and with its steady chug, chug, we began our journey down the river, the power of the boat aided by the swiftly flowing water carrying us along at a rapid rate. If the slow, labored up journey was a revelation with its worries and anxieties, what can be said of the down journey with its kaleidoscopic panorama of sand bars, Indian villages, far-away snowy mountains, dense forests of mighty cottonwoods, lofty heights which tower above us clad to their very summits with eternal green, mountain streams, and innumerable waterfalls and cascades! And what shall one say of that memorable ride through the cañon, the wheel reversed and throwing water over the pilot house, the boat rocking and swaying to and fro! Before we were fairly aware of the fact we were out into that great, deep, silent basin again and off on the home stretch. Apart from taking on wood and stopping at one or two Indian villages, a delay of a few hours was made to permit some mining engineers to examine a mine. They had just come up from the coast and brought with them news of the gold excitement in the Yukon Valley, and now for the first time we heard that magic word "Klondike," which was soon to "electrify the world and put the gold fields of California, South Africa, and Australia to shame."

At nine o'clock we were in Essington once more. "Klondike, Klondike!" on every side. The whole country seemed to have gone daft. One steamer after another went racing by the mouth of the Skeena on the way to Dyea and the Skagway Trail. But our fortunes lay in the other direction, and that night we were aboard the Islander, bound for Victoria and the south.

LIGHT AND VEGETATION.

By D. T. MACDOUGAL, Ph. D.,
PROFESSOR IN CHARGE OF PLANT PHYSIOLOGY, UNIVERSITY OF MINNESOTA.

LIGHT is the most important of all the external agencies which influence the vegetal organism, and the sun's rays have been the most potent force in shaping the development of existent plant forms.

The sunbeam stands in a manifold relation to the plant. First and foremost, light is the universal source of energy, by the aid of which the chlorophyll apparatus in green leaves builds up complex food substances from simple compounds obtained from the soil and air, a process necessary for the nutrition of the entire living world. Some obscure organisms, such as the "nitrosomonas," soil bacteria, are able to accomplish the construction of complex substances, by means of energy derived from other chemical compounds, which were, however, formed originally by green plants. These food-building processes are designated as photosynthesis, chemosynthesis, electrosynthesis, thermosynthesis, etc., according to the source of energy used.

By photosynthesis, carbon dioxide from the air and water from the cell are combined in the green cells of leaves, forming sugar and possibly other substances. During this process an amount of oxygen approximately equal to that of the carbon dioxide taken up is exhaled. It will be of interest to note the relation of the living world to the atmosphere. Eight hundred to nine hundred grammes of carbon dioxide are produced in the respiration of a single person for a day, and the entire product of the human race for this period is twelve hundred million kilogrammes. In addition, large quantities of the gas result from the combustion of the four hundred and sixty millions of kilogrammes of coal and wood burned yearly. The lower animals, fungi, and green plants themselves contribute an amount which must bring the total to twice the immense sum named above. The atmosphere contains three or four hundredths of one per cent of carbon dioxide, or an amount of about two to three thousand billions of kilogrammes. No especial variation in this proportion has been detected since observations upon this point were first made. The fact that no increase takes place is partly due to the absorption of the gas by plants, and its replacement by oxygen, and also to certain geological processes in constant operation. Absorption takes place at the rate of about two and a half grammes for every square metre of leaf surface per hour, or about twenty-five to thirty grammes daily, since the process goes on only in daylight. It is to be seen that a single human being exhales as much carbon dioxide as may be removed from the air by thirty or forty square metres of leaf surface. According to Ebermayer, a hectare (2.47 acres) of forest would use eleven thousand kilogrammes of carbon dioxide yearly, and the amount used by plants is generally much in excess of that furnished by the activity of the inhabitants of any given area. Plants thrive and show increasing vigor as the amount of carbon dioxide in the air rises until two hundred times the present proportion is reached. An increase of the gas in the atmosphere would therefore be partly corrected by the absorption and by the stronger vegetation induced. Nothing short of a comprehensive cataclysm could work such disturbance to the composition of the air as to endanger the well-being of the animal inhabitants of the earth.

The activity of a square metre of leaf surface results in the formation of one and a half to two grammes of solid substance per hour in sunlight. A vigorous sunflower with one hundred and forty-five leaves constructed thirty-six grammes of solid matter in a day, and a squash with one hundred and sixteen leaves one hundred and sixteen grammes in the same length of time. The amounts formed by such trees as the beech, maple, oak, poplar, elm, and horse-chestnut, with leaf surfaces aggregating three hundred to one thousand square metres, must be correspondingly large.

A comparison of plants grown in strong sunlight, diffuse light, and darkness will reveal many differences in stature and internal structure. These differences are for the most part due to the *forma-*

tive and *tonic* effect of light. Otherwise expressed, the influence of variations of light upon plants causes adaptive reactions, and disturbances of the nutritive processes and growth.

In consequence of these facts the reaction of any given organ to changes in the intensity of the illumination will depend upon its specific functions and relation to the remainder of the organism.

The stems formed by seedlings and awakening underground organs are usually surrounded by plants or other objects which cut off more or less sunlight. The developing shoot can not spread its leaves to the light advantageously until it has outstripped or grown beyond the objects intervening between it and the light. This necessity is one of the most important conditions in the struggle for existence. To meet it, a very great majority of seed-forming plants have acquired the power of accelerated elongation of the stems when deprived of their normal amount of light.

Very striking examples of this reaction are offered by the awakening corms of the Jack-in-the-pulpit (*Arisæma triphyllum*). The corms usually lie at a distance of five or six centimetres below the surface of the soil, and when the growth of the large bud begins in the spring the heavy sheathing scales elongate and pierce the soil, opening when the surface is reached at the distance of a few centimetres. If the corm should have been buried deeper in the substratum by floods or drifts of leaves, the growth of the bud scales will continue until the light is reached, though it may be a distance of twenty centimetres. Such growth may be seen if the corms are grown in a deep layer of sphagnum moss, or in a dark room.

After the stems emerge from the "drawn" buds they show a similar attenuation, attaining a length of twice the normal. The excessive elongation of stems is accompanied by variations in the structure and contents of the tissues. The cells are generally longer, while the walls are thinner. In consequence, organs grown in darkness are very weak and easily bent or broken. Growth in darkness is attended by the non-formation of chlorophyll. This is replaced by etiolin, giving the plant a pale, waxy, yellow appearance.

The adaptive elongation is not shown by all species, however. It has been found that stems of beet, hop, dioscorea, and a few others show no adaptations to diminished light. The adaptive modification of stems elongating in darkness is developed from the retarding influence exercised by light upon growth. Thus it is a well-known fact that the action of certain portions of the sun's rays actually impedes or checks the increase in volume known as growth, though it does not influence actual division of the cells to any great extent. When this retarding action is eliminated excessive elongation ensues.

The behavior of leaves in illuminations below the normal depends upon the relation of these organs to the storage structures of the plant as well as upon other factors, and many types are dependent upon their own activity for plastic material necessary for growth.

It is to be said in general that leaves of dicotyledonous plants are incapable of full development in darkness, though to this rule there are many exceptions. Thus the leaves of the beet develop normally, or nearly so, in darkness.

On the other hand, leaves of monocotyledonous plants attain normal size in darkness, especially those with straight or curved parallel venation. Some, as the iris, swamp marigold, and onion, attain a greater length in darkness than in light. Here, as in stems, cell division is not modified, but the growth of the individual cell is increased.

The growth of leaves in darkness may be easily observed if the underground perennial stems of common mandrake are placed in a dark chamber before the growth of the leaf buds has begun. The leaves are peltate, and in the bud are folded about the end of the petiole after the manner of an umbrella. Usually this umbrella expands as soon as it has pushed upward and become free from the soil, attaining a diameter of twenty-five to forty centimetres when outspread. In darkness, however, it refuses to unfold, the laminæ are pale yellow and retain the crumpled form of the bud, and as the petiole shows an exaggerated elongation the organ takes on the appearance of a very small parasol on a very long handle. The imperfect development of leaves and the rapid decay of aërial organs deprived of sunlight leads to the conclusion that the action of light is necessary to the health and normal activity of these organs, and the light therefore exercises a *tonic* influence upon vegetation.

Many species of plants are so plastic and capable of such ready response to variations in external conditions that they undergo distinct morphological changes in response to variations in the intensity of the light. The common potato is an example of this fact. The edible tubers are simply thickened stems, and the plant has the habit of storing starch in any stems not acted upon by the light. The branches arising from the base of the main stem are generally underneath the surface of the soil, and afford the proper conditions for tuber formation. Sugar is constructed in the leaves, carried down the length of the stem, and deposited in the underground branches as starch. Space is made for the accumulating store by the multiplication of the thin-walled cells of the pith. If any of the upper branches should become shaded, they become at once the focus of converging streams of sugar, and similar enlargement ensues, resulting in the formation of tubers. Such structures are occasionally observed in plants grown thickly together.

Vöchting, by a number of most ingenious experiments, has succeeded in producing tubers on any branch of a potato plant by simply inclosing the branch in a small dark chamber. As the result of one experiment the entire main stem springing from a sprouting tuber was converted into a new tuber nearly as large as the first. The entire plant at the close of the experiment had the form of a dumb-bell, with the old tuber as one ball and the new tuber as the other.

The same writer has described important results obtained from a study of the action of light upon the stems of cactus, consisting of a number of flattened internodes. When the growing tips of such plants were allowed to develop in a dark chamber the new internodes grown were cylindrical in form. Such behavior suggests that these plants were originally furnished with cylindrical stems and foliar leaves. The leaves at some time in the history of the plant were found unsuitable, and gradually atrophied, while the stems were flattened and extended to take up their functions.

Some very striking adaptations of form of organs to the intensity of the light have been analyzed by Goebel. The common harebell (*Campanula rotundifolia*) has an upright stem twenty to sixty centimetres in height. The upper part of the stem bears sessile lanceolate leaves, decreasing in size from the base to the summit. The first leaves formed by the stem on its emergence from the soil are entirely different in construction, showing a heart-shaped lamina with a distinct petiole. These leaves are formed at the actual surface of the soil, are generally more or less shaded or covered by fallen leaves, and in fact are not known or seen by many collectors or observers of the plant. Goebel found that similar leaves might be formed on any part of the plant if it were shaded from the full glare of the sun's rays. The cordate leaves at the base of the stem were always produced, however, no matter to what intensity of illumination that part of the plant was subjected. It is therefore safe to conclude that the cordate leaves are inherited forms, and that the lanceolate organs are adaptations to light which may be shown by any individual of the species.

In general it is to be said that the leaves of sun-loving species have a thick epidermis, entirely free from chlorophyll, with stomata on the lower side only, a firm consistence due to the formation of woody tissues, and are often provided with a coating of hairs. The leaves of shade-loving plants, on the other hand, have a thin-walled epidermis often containing chlorophyll, stomata on both sides, and are not so plentifully provided with hairs as those in exposed situations.

The variations in external form described above are due to the intensity of the illumination. At the same time the structure and arrangement of the cells depend on the direction from which the light rays come. Thus, an organ receiving light from one side only will exhibit a structure different from an organ of the same kind receiving direct rays from two or more sides. Light, then, is a cause of dorsiventrality—that is, of the fact that the upper and lower sides of organs are not alike in structure. The leaf affords a splendid example of dorsiventrality as a result of the exposure of one side only to direct light. The upper side of a horizontal leaf, such as the oak, beech, or maple, contains one or two layers of cylindrical cells with their long axes perpendicular to the surface. In vertical leaves, such as the iris, these *palisade* cells, as they are termed, are not so well defined, and in all leaves grown in darkness this tissue is very much reduced. If a young leaf not yet unfolded from the bud is fastened in such a position that the under side is uppermost, palisade cells will be formed on the side exposed to the direct rays of the sun.

The influence of light upon the sporophylls, or reproductive organs of the seed-forming plants, is quite as well defined as upon the vegetative organs.

In general it is to be said that stamens and pistils may reach functional maturity in darkness or diffuse light, and if pollination is provided for, seed and fruit formation may ensue.

The diminution of light has the effect of transforming inflorescences into leafy shoots in some instances, however. The more common reaction consists of alterations in the size, form, and color of the perianth, and greater changes are induced in the petals than in the sepals. The corolla shows greater decrease in size in *Melandryum* and *Silene*, in diffuse light, though the relative form is maintained. The writer has obtained most striking results from growing flowers of *Salvia* (sage) in a dark chamber, inclosing the inflorescence only. In the normal flower the irregular scarlet corolla attains three times the length of the calyx, and two stamens extrude from under the upper lip. When grown in darkness, the corolla with the adherent stamens measure about three millimetres in length, or one twelfth the normal, and are scarcely more than half the size of the calyx, which is but two thirds the size of similar organs grown in the light. The color is entirely lacking from the corolla, and is found only along the veins of the calyx.

In other instances in which the corolla is composed of separate members, an unequal reaction is exhibited. The corolla of nasturtium (*Tropæolum majus*) consists of five approximately equal petals. Flowers of this species grown in darkness show one of nearly normal stature, two of reduced size, while the remaining two take the form of club-shaped bracts.

The diminished size of the perianth of cleistogamous flowers of such types as the violet is due directly to the action of diminished light upon the hidden or inclosed flower.

The influence of light upon the structure, reproductive processes, and distribution of the lower forms brings about the most widely divergent reactions, which can not be described here.

The distribution and color of marine algæ depend upon the depth of the water and the consequent intensity of the light. This gives rise to distinct zones of aquatic vegetation. Thus in one series of surveys the *littoral* zone, the beach area covered at high water and exposed at low water, was found to furnish proper conditions for green, brown, and red algæ. The *sublittoral* zone, extending to a depth of forty metres, is furnished with red algæ, increasing in number with the depth, and the brown algæ disappear; while the *elittoral* zone, from forty to one hundred and ten metres, is inhabited by red algæ alone. The number of species of vegetal organisms below this depth is extremely small. An alga (*Halosphæria viridis*) has been brought up from depths of one thousand to two thousand metres.

A very great number of bacteria are unfavorably affected by light, and find proper conditions at some depth in the soil or water. It is on account of this fact that the water of frozen streams becomes more thickly inhabited by certain organisms than in the summer time, and exposure to sunlight is adopted as a hygienic measure in freeing clothing and household effects from infection. Bacteria occur abundantly in sea water at depths of two hundred to four hundred metres, and quite a number of species are to be found at eight hundred to eleven hundred metres.

The distribution of fungi follows the general habit of bacteria in that they thrive best in darkness.

It is to be noticed in this connection that light is also a determining factor in the distribution of the higher land plants. Thus the amount of light received in polar latitudes is quite insufficient for the needs of many species, entirely irrespective of temperature.

The retarding influence of light upon growth is even more marked in the lower forms than in the higher. Such action is the result of the disintegrating effect of the blue-violet rays upon ferments and nitrogenous plastic substances.

The greater massiveness of the bodies of the higher plants enables them to carry on the chemical activities in which these substances are concerned in the interior, where the intense rays may not penetrate. The attenuated and undifferentiated fungi must seek the shade, to escape the dangers of strong light, against which they have no shield.

The reproductive processes are particularly sensitive to illumination. The formation of zoöspores by green felt (*Vaucheria*) may occur only in darkness, at night, or in diffuse light, and these examples might be multiplied indefinitely. Many features of the germination of spores and the growth of *protonemæ* or *prothallia* among the mosses, liverworts, and ferns are determined by light.

Perhaps the most striking reactions of plants to light are to be seen in locomotor and orientation movements.

Locomotor movements are chiefly confined to lower forms, and are most noticeable in the "swarm spores," or zoöspores of the algæ, though exhibited by spermatozoöids as well. Zoöspores may be seen collected against the side of the vessel receiving direct sunlight, while the opposite side of the vessel will be free from them. The chlorophyll bodies of green cells arrange themselves similarly. The latter bodies may move away from the exposed side of the cell if the light exceeds a certain intensity.

The typical plant may not move its body toward or away from the source of light, but it may secure the same end by dispositions of its surfaces to vary the angle at which the rays are received. This form of irritability is one of the most highly developed properties of the plant. Wiesner has found that a seedling of the vetch is sensitive to an amount of light represented by one ten-millionth of a unit represented by a Roscoe-Bunsen flame. The "sensitiveness" to light may take one of three forms: The organ may place its axis parallel and pointing toward the source of the rays, as in stems, when it is said to be *proheliotropic;* the axis of the organ may assume a position perpendicular to the rays, which is designated as *diaheliotropism;* or it may place its axis parallel to the rays and pointing away from the light, when it is said to be *apheliotropic.* Upright stems are proheliotropic, horizontal leaves and creeping stems are diaheliotropic, and roots and such stems as those of ivy are apheliotropic.

Sunlight varies from zero to the full blaze of the noonday sun, and assumes its greatest intensity in the equatorial regions. The intensity in latitudes 40° to 45° north would be represented by 1.5 units, and at the equator by 1.6 units. Near the equator the intensity is so great that an ordinary leaf may not receive the full force of the noonday sun without damage. The injury would not result from the luminous rays, but from the temperatures, 40° to 50° C., arising from the conversion of light into heat. As an adaptation to this condition nearly all leaves have either a pendent or a vertical position, or the power of assuming this position by motor or impassive wilting movements.

Among the plants of the temperate zone the so-called compass plants are examples of similar adaptations. The compass plants include, among others, the wild lettuce (*Lactuca scariola*) and rosin weed (*Silphium laciniatum*). These plants place the leaves in a vertical position with the tips pointing north and south in such manner that the direct rays of the morning and evening sun only may strike the surfaces at right angles, while the edges are presented to the fierce rays at noonday. That this arrangement is an adaptation against the intense light is evident when it is seen that specimens growing in shaded locations or in diffuse light place the leaves in the typical horizontal position. To meet the functional conditions, both sides of the compass leaves are almost equally provided with palisade cells for food formation and stomata for transpiration. The estimation of the light striking a compass leaf shows that it receives approximately the same amount of light as a horizontal leaf during the course of a day, but the two maxima of intensity, morning and evening, are much below that of the noon of horizontal leaves.

The influence of light upon plants may be briefly summed as follows:

Light is necessary for the formation of food substances by green plants, and it is an important factor in distribution in land and marine forms.

Growth and reproduction are generally retarded by the action of the blue-violet rays.

Light is fatal to certain bacteria and other low forms of vegetable life.

Many plants have the power of accelerated growth of stems in diminished light as an adaptation for lifting the leaves above "shading" objects.

The growth of many leaves and of the perianth of flowers is hindered in diminished light.

The outward form of many organs, particularly leaves, is dependent upon the intensity of the light received.

The internal structure of bilateral or dorsiventral organs is largely determined by the direction of the rays.

Plants have the power of movement to adjust their surfaces to a proper angle with impinging light rays, as a protective adaptation.

MATCHES which do not contain any phosphorus and which take fire by friction on any surface—a match that has been long sought—have been prepared by Mr. S. A. Rosenthal and Dr. S. J. von Kornocki. It is represented that they can be manufactured as cheaply as ordinary matches.

THE STONE AGE IN EGYPT.

By J. DE MORGAN.

THE investigation of the origin of man in Egypt is a very complex problem, belonging as much to geology as to archæology. The earliest evidences we have of human industry, in fact, go back to so remote a period that they should be regarded rather as fossils than as archæological documents. They are very coarsely worked flints, which are found near the surface of the ground among the pebbles of the Quaternary or Pleistocene epoch, and similar to those which occur abundantly in Europe, America, and Asia; but the study and collection of them have been pursued with less method than in those countries. The more recent monuments, so much more conspicuous and more easily accessible, have attracted most attention, while these have been left in the background.

No region in the world presents a clearer and more distinct individual character than Egypt. Each village is a special world, each valley a universe that has developed its own life; and man has felt the special local impressions; and even in modern times, while all the Egyptian villages present a similar aspect, and although the fellah appears to be the same sort of a man everywhere, each locality has its special individual characteristics. One who knows how to observe men and things critically will find considerable differences. These dissimilarities are as old as Egypt itself. They have always existed, and are as much more intense as the communications between district and district were formerly more difficult. They are due to physical conditions special to each village, to the prevailing winds, the form and character of the mountains, the extent of cultivable lands, and the supply of water. A study of the detail of the country is a very important preliminary to the examination of Egyptian history. Every village and every nome had formerly its special divinity and its particular usages. Are we sure that the gods and customs were not imposed by local conditions? At Ombos two hostile gods were adored in the same temple. May we not see in this fact a recollection of the hostility which has always prevailed between the inhabitants of the two banks of the river, and still continues?

Previous, however, to investigating these details which have been so influential on Egyptian civilization, we ought to dispel the darkness which hides from us the earliest traces of man in the valley of the Nile, and examine how man lived in his beginning, to study the geology of the country and its condition when it issued from the seas. As one of the results of this study we find that palæolithic man, known to us only through the rough-cut flints we find in the alluvions, made his first appearance. After this period of excavation came that of filling up with silt, which still continues. New evidences of man appear in his burial places and the ruins of his villages, the kitchen middens which he has left in his habitations of unburned brick and in his camps. This time he is more civilized; he chips his flints with a skill that is not surpassed in European neolithic implements; he makes vessels of stone and clay, covers them with rude paintings, sculptures animal forms of schist, and wears necklaces of the shells and the stones of the country. Then comes a foreign people to take possession of Egypt, bringing knowledge of metals, writing, hieroglyphics, painting, sculpture, new industries and arts that have nothing in common with the arts of the people it has overcome. The ancient Pharaonic empire begins, or perhaps the reign of the divine dynasties. The men with stone implements are the aborigines; the others are the conquering civilized Egyptians. Nothing can be more interesting than a comparison of the arts of the aborigines and those of the Egyptians of the earlier dynasties. Nearly all their characteristics are different, and it is impossible to regard them as of common origin. Yet some of the native forms persisted till the last days of the empire of the Pharaohs. These aborigines belonged to a race that is now extinct, they having been absorbed into the mass of the Egyptians and Nubians among whom they lived, and from this mixture the fellah of ancient times is derived. The origin of the conquering race—of the Egyptians as we know them—has not been precisely determined. The weight of evidence, so far as it has been obtained, and the balance of opinion, are in favor of an Asiatic origin and of primary relationship with the Shemites of Chaldea.

In Egypt more than in any other country it is necessary to proceed with the most scrupulous circumspection in the examination of remote antiquities. The relics of thousands of years of human life have been piled one upon another and often intermixed. The questions they raise can not be answered in the cabinet or by the study of texts; but the inquiry must be prosecuted on the ground, by comparison of the deposits where they are found and in the deposits from which they are recovered.

From my first arrival in Egypt, in 1892, my attention has been greatly occupied with the question of the origin of the relics of the stone age that have been found from time to time in that country. I have gathered up the scattered documents, explored a large number of sites, and have bought such flint implements as I have found on sale. I have gradually been led to believe that while some of these cut stones may possibly belong to the historical epoch, we shall have to attribute a much more remote antiquity to the most of them, and that evidences of a neolithic age in the valley of the Nile are more abundant than has generally been supposed.

In many minds the historical antiquity of Egypt, the almost fabulous ages to which its civilization ascends, seem to challenge the history of other countries, and the land of the Pharaohs, rejecting all chronological comparison, to have appeared in the midst of the world as a single example of a land which savage life had never trodden. Yet what are the centuries since Menes ruled over the reclaimed valleys, the few thousand years of which we can calculate the duration, by the side of the incalculable lapse of time since man, struggling with the glaciers and the prehistoric beasts, began his conquest of the earth? The antiquity of Egypt, the eight thousand years (if it be as many) since the first Pharaoh, are only as an atom in the presence of these ages. We can assert some vague knowledge of these pre-Pharaonic inhabitants, for two hatchets of the Chellean pattern were found some time ago in the desert, one at Esnet, the other near the pyramids of Gizeh; and we can now affirm in the most positive manner that Quaternary man lived in the country which is now Egypt, and was then only preparing to be. Four palæolithic stations have been more recently discovered—at Thebes, Tukh, Abydos, and Daschur. Join these sites to the other two where isolated pieces were found, and we have the geography of what we know at present of Chellean man in the valley of the Nile. Doubtless continuous researches would result in similar discoveries at other points, for I have met these relics wherever I have been able to make a short sojourn. The Chellean implements are found in the gravels of the diluvium on the pebbly surface. They have been disturbed and probably scattered, but some places yield them more numerously than others—points possibly corresponding to the ancient workshops. I have found a considerable number of specimens at Deir-el-Medinet; M. Daressy, of the Bureau of Antiquities, found a perfectly characteristic Chellean hammer stone in the Valley of the Queens at Gurneh, as perfectly worked as the best specimens found at Chelles, St. Acheul, and Moulin-Quignon.

The finds are not very numerous at Tukh, but one may in a few hours make a collection there of hatchets (or hammer stones), scrapers, points, simple blades, and a large number of stones bearing indisputable marks of having been worked, but not presenting precise forms. The deposit at Abydos is in the bottom of a circle behind the ruins surrounding the Pharaonic necropolis. The specimens seem sufficient to prove the existence of Quaternary man in Egypt, while the search for them has hardly yet begun. In view of them it is extremely improbable that man did not also exist there during the long period that intervened between this primitive age and that of the earliest Egyptians who had metals. He did exist there then, and the evidences of it are found in neolithic remains between Cairo and Thebes, a distance of about eight hundred kilometres along the valley of the Nile, in the Fayum, and in Upper Egypt. Among these are the remarkable tombs at Abydos which have been explored by M. E. Amélineau, and of which he has published descriptions. They belong to a category which I have characterized as tombs of transition and as signalizing the passage from the use of polished stone to that of metals. Their archaic character can not be disputed, and their royal origin is probably certain. They may belong to aboriginal kings or to the earliest dynasties. They reveal a knowledge of brass and of the use of gold for ornament. At the necropolis of El-'Amrah, a few miles south of Abydos, are some archaic tombs, all of the same model, composed of an oval trench from five to six and a half feet deep. The body is laid on the left side, and the legs are doubled up till the knees are even with the sternum; the forearms are drawn out in front and the hands placed one upon the other before the face, while the head is slightly bent forward. Around the skeleton are vases, and large, rudely made urns, often filled with ashes or the bones of animals, and nearer to them are painted or red vessels with black or brown edges, vessels roughly shaped out of stone, and figurines in schist representing fishes or quadrupeds, cut flints, alabaster clubs, and necklaces and bracelets of shells. Bronze is rare, and found always in shape of small implements. Both purely neolithic tombs and burials of the transition period to metals occur at El-'Amrah. The most remarkable feature of the burials is the position of the corpse, totally unlike anything that is found of the Pharaonic ages.

The Egyptian finds of stone implements present the peculiarity as compared with those of Europe, that types are found associated together belonging to what would be regarded in other countries as very different epochs. The time may come when subdivisions can be made of the Egyptian stone age, but the study has not yet been pursued far enough to make this practicable at present. Among these articles are hatchets showing the transitions, examples of which are wanting in Europe, from the rudest stone hammer to the polished neolithic implement; knives of various shape and some of handsome workmanship; scrapers, lance heads, arrowheads, saws, pins, bodkins, maces, beads, bracelets, and combs. The large number of instruments with toothed blades found at some of the stations may be regarded as pointing to a very extensive cultivation of cereals at the time they were in use. The deposits of Tukh, Zarraïdah, Khattarah, Abydos, etc., situated in regions suitable for growing grain, yield thousands of them, while they are very rare at the fishing station of Dimeh. That the use of sickles tipped with flint very probably lasted long after the introduction of metals seems to be proved by the hieroglyphics; but very few evidences of the existence of such tools are found after the middle empire.

No traces of articles related to the religion of the Pharaohs are found in the burial places of the aborigines. In place of the statuettes and funerary divinities of later times are found rude figurines of animals cut in green schists. They represent fishes, tortoises with eyes adorned with hard stone or nacre, and numerous signs the origin of which is unknown, and were apparently regarded as fetiches or divinities. Articles of pottery are very numerous, very crude, and of a great variety of forms. It is not necessary to suppose that the people who have left these relics were savages or barbarians. History and even the present age afford instances of many peoples who have obtained considerable degrees of civilization while backward in some of the arts. It is hardly possible to achieve delicacy of design and finish without the use of metals. I believe I have shown that an age of stone once existed in Egypt, and that it furthermore played an important part, even in Pharaonic civilization.—*Translated for the Popular Science Monthly from the Author's Recherches sur les Origines de l'Egypte.*

SUPERSTITION AND CRIME.

By Prof. E. P. EVANS.

IN January, 1898, an elderly woman came in great anxiety to a priest of the Church of St. Ursula, in Munich, Bavaria, and complained that the devil haunted her house at night and frightened her by making a great noise. In explanation of this unseasonable and undesirable visit from the lower world she stated that a joint-stock company had been formed in Berlin, with a branch in Munich, for the purpose of discovering hidden treasures, and that in order to attain this object a human sacrifice must be made to the devil, and that she had been selected as the victim. A woman, whose husband was a stockholder in the aforesaid company, had kindly communicated to her this information, so that she might be prepared and have time to set her house in order. Satan, however, grew impatient of the promised sacrifice, and began to look after her. The priest sent one of his younger assistants at the altar to read appropriate prayers in the haunted house, and thus exorcise the evil spirit. We can hardly suppose that his reverence believed in the reality of the reported apparition, and yet he could not assert its impossibility by calling in question the existence of the devil or the actuality of diabolical agencies in human affairs without undermining the foundations of the ecclesiastical system, of which he was an acknowledged supporter. Such a declaration would "take away our hope," as the Scotchman said of the denial of a literal hell-fire and the doctrine of eternal punishment. It was for the same reason that the great body of the Catholic clergy, from Pope Leo XIII and the highest dignitaries of the church down to the humblest country vicar, so easily fell into the snares laid by Leo Taxil and accepted the signature of the devil Bitru as genuine, and his revelations concerning the pact of the freemasons with Satan as authentic. It is certainly somewhat startling to meet with such a case of gross superstition as the above-mentioned in one of the seats of modern science and centers of European civilization. In rural districts, remote from the influences of intellectual culture, however, instances of this kind are of quite frequent occurrence, and often result in the commission of crime. Human sacrifices to Satan are still by no means uncommon in many parts of Russia, and are supposed to be effective in warding off famine and in staying the ravages of pestilence. Even in Germany and other countries of western Europe the belief in their prophylactic virtue is remarkably prevalent, and would be often put into practice were it not for the stricter administration of justice and the greater terror of the law.

In October, 1889, the criminal court in the governmental province of Archangelsk, in northern Russia, sentenced a Samoyede, Jefrern Pyrerka, to fifteen years' imprisonment with hard labor for the murder of a maiden named Ssavaney. His sole defense was that an unusually severe winter with a heavy fall of snow had produced a famine followed by scurvy, of which all his children had died. He therefore made an image of the devil out of wood, smeared its lips with fat, and set it up on a hillock. He then attempted to lasso one of his companions, Andrey Tabarey, and had already thrown the noose round his neck, when the energetic wife of the intended victim intervened and rescued her husband. Shortly afterward he succeeded in strangling the girl and offering her as a sacrifice to his idol. In the province of Novgorod, known as "the darkest Russia," it is a general custom among the country people to sacrifice some animal, usually a black cat, a black cock, or a black dog, by burying it alive, in order to check the spread of cholera. In the village of Kamenka, a peasant, whose son had died of this disease, interred with the body eight live tomcats. The immolation of dumb animals, however, is deemed less efficacious than that of human beings. On one occasion, when the cholera was raging severely, a deputation of peasants waited upon their parson, stating that they had determined to bury him alive in order to appease the demon of the plague. He escaped this horrible death only by apparently acceding to their wishes and craving a few days' respite in order to prepare for such a solemn ceremony; meanwhile he took the measures necessary to secure his safety and thwarted the purpose of his loving parishioners. In Okopovitchi, a village of the same province, the peasants succeeded in enticing an aged woman, Lucia Manjkov, into the cemetery, where they thrust her alive into the grave containing the bodies of those who had died of the epidemic, and quickly covered her up. When brought to trial they proved that they had acted on the advice of a military surgeon, Kosakovitch, who was therefore regarded as the chief culprit, and sentenced to be knouted by the hangman, and then to undergo twelve years' penal servitude in Siberia. We are indebted for these instances of barbarous superstition to the researches of Augustus Löwenstimm, associate jurisconsult in the department of justice at St. Petersburg, who has derived them from thoroughly authentic and mostly official sources. He reports several occurrences of a similar kind during the epidemics of cholera in 1831, 1855, and 1872. Indeed, it is very difficult to abolish such pagan practices so long as the clergy foster the notion that animal sacrifices are expiatory and propitiatory in their effects. In some parts of the province of Vologda it is still customary on the day dedicated to the prophet Elias (July 20th in the Greek calendar) to offer up bullocks, he-goats, or other quadrupeds within the precincts of the church. The animal is driven into the courtyard surrounding the sacred edifice and there slaughtered; the flesh is boiled in a large kettle, one half of it being kept by the peasants who provide the sacrifice, while the other half is distributed among the priests and sacristans.*

The belief that the walls of dams, bridges, aqueducts, and buildings are rendered preternaturally strong by immuring a living human being within them still prevails in many countries of Christendom, and there is hardly an old castle in Europe that has not a legend of this sort connected with it. Usually a child is supposed to be selected for this purpose, and the roving bands of gypsies are popularly accused of furnishing the infant victims. The custom of depositing gold coins or other precious objects in the foundation stones of important public edifices is doubtless a survival of the ancient superstition.†

* Löwenstimm's studies, printed originally in the Journal of the Ministry of Justice in St. Petersburg, have been made accessible to a larger class of readers by being collected and translated into German in a volume entitled Aberglaube und Strafrecht (Berlin: Räde, 1897), with an introduction by Prof. Joseph Kohler, of the University of Berlin.

† As the Siberian Railway approached the northern boundaries of the Chinese Empire and surveys were made for its extension through Manchuria to the sea, great excitement

Löwenstimm mentions a curious superstition of pagan origin still practiced in portions of Russia, and known as "*korovya smertj*" (cow-death) and "*opachivaniye*" (plowing roundabout). If pestilence or murrain prevails in a village, an old woman of repute as a seeress or fortune-teller enters the confines of the village at midnight and beats a pan. Thereupon all the women of the place assemble in haste, armed with divers domestic utensils—frying-pans, pokers, tongs, shovels, scythes, and cudgels. After shutting the cattle in their stalls, and warning the men not to leave their houses, a procession is formed. The seeress takes off her dress and pronounces a curse upon Death. She is then hitched to a plow, together with a bevy of virgins and a misshapen woman, if such a one can be found, and a continuous and closed furrow is drawn round the village three times. When the procession starts, the image of some saint suitable to the occasion, that of St. Blasius, for example, in the case of murrain, is borne in front of it; this is followed by the seeress, clad only in a shift, with disheveled hair and riding on a broomstick; after her come women and maidens drawing the plow, and behind them the rest of the crowd, shrieking and making a fearful din. They kill every animal they meet, and if a man is so unfortunate as to fall in with them he is mercilessly beaten, and usually put to death. In the eyes of these raging women he is not a human being, but Death himself in the form of a were-wolf, who seeks to cross their path and thus break the charm and destroy the healing virtue of the furrow. The ceremony varies in different places, and generally ends by burying alive a cat, cock, or dog. In some districts the whole population of the village, both men and women, take part in the procession, and are often attended by the clergy with sacred images and consecrated banners. During the prevalence of the pest in the province of Podolia, in 1738, the inhabitants of the village of Gummenez, while marching in procession through the fields, met Michael Matkovskij, a nobleman of a neighboring village, who was looking for his stray horses. The strange man, wandering about with an eager look and a bridle in his hand, was regarded as the incarnate pestilence, and was therefore seized and most brutally beaten and left lying half naked and half dead on the ground. At length he recovered his senses and succeeded with

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was produced in Pekin by the rumor that the Russian minister had applied to the Empress of China for two thousand children to be buried in the roadbed under the rails in order to strengthen it Some years ago, in rebuilding a large bridge, which had been swept away several times by inundations in the Yarkand, eight children, purchased from poor people at a high price, were immured alive in the foundations. As the new bridge was firmly constructed out of excellent materials, it has hitherto withstood the force of the strongest floods, a result which the Chinese attribute, not to the solid masonry, but to the propitiation of the river god by an offering of infants.

great difficulty in reaching his home. No sooner was it known that he was still alive than the peasants rushed into his house, dragged him to their village, subjected him to terrible tortures, and finally burned him. A curious feature of these remedial rites is the mixture of paganism and Christianity which characterizes them; and it is an unquestionable though almost incredible fact that their atoning efficacy is often quite as firmly believed in by the village priests of the Russian Church as by the most ignorant members of their flock. In the autumn of 1894 some Russian peasants in the district of Kazan slew one of their own number as a sacrifice to the gods of the Votiaks, a Finnish race dwelling on the Volga, Viatka, and Kama Rivers. Even orthodox Christians of the Greek Church, although regarding these gods as devils, fear and seek to propitiate them, especially in times of public distress.

Still more widely diffused is the practice of infanticide as the sequence of superstition. The belief that dwarfs or gnomes, dwelling in the inner parts of the earth, carry off beautiful newborn babes and leave their own deformed offspring in their stead is not confined to any one people, but is current alike in Germanic, Celtic, Romanic, and Slavic countries, and causes a misshapen child to be looked upon with suspicion and subjected to cruel tortures and even killed. The supposed changeling is often severely beaten with juniper rods and the scourging attended with incantations, so as to compel the wicked fairies to reclaim their deformed bantling and restore the stolen child. If the castigation proves ineffective, more summary measures are frequently taken, and the supposititious suckling is thrown out of the window on a dunghill or immersed in boiling water. In 1877, in the city of New York, an Irish immigrant and his wife burned their child to death under the delusion that they were ridding themselves of a changeling. Cases of this kind are quite common in Ireland, where the victims are sometimes adults.* Not long since Magoney, an Irish peasant, had a sickly child, which the most careful nurture failed to restore to health and strength. The parents, therefore, became convinced that a changeling had been imposed upon them, and when the boy was four years old they resolved to have recourse to boiling water, in which he was kept, notwithstanding his shrieks and protestations that he was not an elf, but their own Johnny Magoney, until death released him from his torments.

Wilhelm Mannhardt, the celebrated writer on folklore, states that when, in 1850, he was in Löblau, a village of West Prussia, he saw a man brutally maltreating a boy on the street. On inquiry he

* See the case of Bridget Cleary, reported in Appletons' Popular Science Monthly for November, 1895, p. 86. We may add that her husband, Michael Cleary, was tried for murder and sentenced to twenty years' penal servitude.

found that the lad had done nothing worthy of blame, but that his only fault was an exceptionally large head. This cranial peculiarity, offensively conspicuous in what seems to have been a narrow-headed family, was reason enough for the parents to disown their offspring, and to treat him as the counterfeit of a child foisted in by the fairies. At Hadersleben, a considerable market town of North Silesia, the wife of a farmer, in 1883, gave birth to a puny infant, which the parents at once assumed to be a changeling. In order to defeat the evil designs of the elves and to compel the restoration of their own child, they held the newborn over a bed of live coals on the hearth until it was covered with blisters and died in intense agony. In East Prussia, the Mazurs, a Polish race, whose only notable contribution to modern civilization and the gayety of nations is the mazurka, take precautionary measures by placing a book (usually the Bible, although any book will do) under the head of the newborn babe, so as to prevent the devil from spiriting it away and substituting for it one of his own hellish brood, thus unwittingly furnishing a marvelous illustration of the beneficent influence of the printing press and the magic power of literature. The Estnian inhabitants of the island of Oesel in Livonia refrain from kindling a fire in the house while the rite of baptism is being celebrated, lest the light of the flames should render it easier for Satan surreptitiously to exchange an imp for the infant. After the sacred ceremony has been performed there is supposed to be no danger of such a substitution.

One of the most incredible instances of this extremely silly and surprisingly persistent superstition occurred in 1871 at Biskunizy, a village of Prussian Posen, where a laborer, named Bekker, had by industry and frugality gradually acquired a competence and been able to buy a house of his own, in which he led a happy domestic life with his wife and five children, of whom he was very fond. After fourteen years of unbroken felicity the wife's elder sister, Marianne Chernyāk, came from Poland to pay them a visit. This woman was a crackbrained devotee, who spent half her time in going to mass and the other half in backbiting her neighbors. She also claimed that she could detect at once whether a person is in league with Satan, and could cast out devils. The villagers came to look upon her as a witch, and avoided all association with her, especially as her aberrations manifested themselves in exceedingly malevolent and mischievous forms. Unfortunately, she acquired complete ascendency over her younger sister, who accepted her absurd pretensions as real. On November 19, 1871, Marianne, after returning from confession, went to bed, but at midnight Mrs. Bekker, who slept with her youngest child, a boy about a year old, was awakened by a fearful shriek and lit the lamp. Thereupon the sister rushed into the room, crying: "The demons have stolen your child and put a changeling in your bed: beat him, beat him, if you wish to have your child again!" Under the influence of this suggestion, which seemed to be almost hypnotic in its character, the bewildered mother began to beat the boy. The aunt now seized him and swung him to and fro, as if she would fling him out of the window, at the same time calling out to Satan: "There! you have him; take your brat!" She then gave him back to his mother with the words: "Throw him to the ground, drub him, beat him to death; otherwise you will never recover your child." This advice was followed, and the boy severely strapped with a heavy girdle as he lay on the floor. Meanwhile Bekker, hearing the noise, got up and at first tried to intervene for the protection of his son, but was easily convinced by his wife that she was doing the right thing, and persuaded to aid her in discomfiting the devil by beating the boy with a juniper stick. The process of exorcism, thus renewed with increased vigor, soon proved fatal. At this juncture, as the son of the aunt, a lad of five years, threw himself down with loud lamentations beside the dead body of his little cousin, his mother cried out: "Beat him; he is not my child! Why should we spare him? We shall get other children!" Thereupon he, too, was maltreated in the same manner until he expired. The aunt then declared that the devil had crept into the stovepipe, and went to work to demolish the stove, but, when she was prevented from doing so, fled into the garden, where she was found the next morning by the school-teacher. By this time Bekker and his wife seem to have come to their senses, and were sitting by the corpses of the murdered children, weeping and praying, as the neighbors entered the house. The trial, which took place at Ostrov in January, 1872, led to the introduction of conflicting expert testimony concerning the mental soundness of the accused, and the matter was finally referred to a commission of psychiaters in Berlin, who decided that Bekker and his wife were not suffering from mental disease, and therefore not irresponsible, but that the aunt was subject to periodical insanity to such a degree as not to be accountable for her actions. Curiously enough, the jurors remained uninfluenced by this testimony, and pronounced her guilty of the crime laid to her charge, and in accordance with this verdict the court sentenced her to three years' imprisonment with hard labor. The jurors even went so far as to declare that she herself did not believe in the existence of elf children or satanic changelings, but made use of this popular superstition for her own selfish purposes, and that she guilefully denounced her own boy as an imp in order to get rid of him. In this verdict, or rather in the considerations urged in support of it, it is easy to perceive the effects of strong local prejudice against the accused, who had the reputation of being a lazy, malicious, and crafty person, and was therefore denied the extenuation of honest self-deception. Indeed, in such cases it is always more or less difficult to determine where sincere delusion ceases and conscious swindling begins. Just at this point the annals of superstition present many puzzling problems, the solution of which is of special interest as well as of great practical importance not only to the psychologist and psychiater, but also to the legislator and jurisprudent, who have to do with the enactment and administration of criminal laws.

In the penal codes of the most civilized nations the agency of superstition as a factor in the promotion of crime is almost wholly ignored, and, as this was not the case in former times, the omission would seem to assume that the general diffusion of knowledge in our enlightened age had rendered all such specifications obsolete and superfluous. Only in the Russian penal code, especially in the sections *Ulosheniye* and *Ustav* on felonies and frauds, as cited by Löwenstimm, do we find a distinct recognition and designation of various forms of superstition as incentives to crime. Thus, in paragraph 1469 of the first of these sections, the murder of "monstrous births or misshapen sucklings" as changelings is expressly mentioned, and the penalty prescribed; and in other clauses of the code punishments are imposed for the desecration of graves and mutilation of corpses, in order to procure talismans or to prevent the dead from revisiting the earth as vampires, and for various offenses emanating from the belief in sorcery and diabolical possession. The practice of opening graves and mutilating dead bodies is quite common, and arises in general from the notion that persons who die impenitent and without extreme unction, including suicides and victims to delirium tremens, apoplexy, and other forms of sudden death, as well as schismatics, sorcerers, and witches, come forth from their graves and wander about as vampires, sucking the blood of individuals during sleep and inflicting misery upon entire communities by producing drought, famine, and pestilence. The means employed to prevent this dangerous metamorphosis, or at least to compel the vampire to remain in the grave, differ in different countries. In Russia the deceased is buried with his face downward, and an ashen stake driven through his back, while in Poland and East Prussia the corpse is wrapped up in a fish net and covered with poppies, owing, doubtless, to the soporific qualities of this plant. Preventive measures of this kind are often taken with the consent and co-operation of the clergy and local authorities. Thus, in 1849, at Mariensee, near Dantzig, in West Prussia, a peasant's wife came to the Catholic priest of the parish and complained that an old woman named Welm, recently deceased, appeared in her house and beat and otherwise tormented her child. The priest seems to have accepted the truth of her statement, since he ordered the corpse to be disinterred, decapitated, reburied at a cross-road, and covered with poppies. In 1851, during the prevalence of cholera in Ukraine, in the governmental province of Kiev, the peasants of Possady attributed the epidemic to a deceased sacristan and his wife, who were supposed to roam about at night as vampires and kill people by sucking their blood. In order to stay the ravages of the scourge the corpses of this couple were exhumed, their heads cut off and burned, and ashen stakes driven through their backs into the ground. In 1892 a peasant woman in the Russian province of Kovno hanged herself in a wood near the village of Somenishki. The priest refused her Christian burial because she had committed suicide, and was therefore given over to the devil. In order that she might rest quietly in her grave and not be changed into a vampire, her sons severed her head from her body and laid it at her feet. In thus refusing to perform religious funeral rites the priest obeyed the canons of the church and also the laws of the Russian Empire. Until quite recently a corner of unconsecrated ground next to the wall of the Russian cemetery was reserved as a sort of carrion pit for the corpses of self-murderers, and it is expressly prescribed in the *Svod Sakonov* * that they "shall be dragged to such place of infamy by the knacker, and there covered with earth." This treatment of a *felo-de-se* by the ecclesiastical and civil authorities directly fosters popular superstition by tending to confirm the notion that there is something uncanny, eldritch, demoniacal, and preternaturally malignant inherent in his mortal remains, a notion still further strengthened by a most unjust paragraph (1472) in the Russian code, which declares the last will and testament of a suicide to have no legal validity. Drought, too, as well as pestilence, is ascribed to the evil agency of vampires, which "milk the clouds," and hinder the falling of the dew. In 1887 the South Russian province of Cherson began to suffer from drought soon after a peasant had hanged himself in the village of Ivanovka, the inhabitants of which, assuming a causative connection between the aridity and the self-homicide, poured water on the grave while uttering the following words: "I sprinkle, I pour; may God send a shower, bring on a little rainfall, and relieve us from misery!" As this invocation failed to produce the desired effect, the body was taken up and inhumed again in a gorge outside of the village. In some districts the corpse is disinterred, beaten on the head, and drenched with water poured through a sieve; in others it is burned.

* General Code, vol. xiii, edition of 1892, cited by Löwenstimm.

The records of the criminal courts in West Prussia during the last half century contain numerous instances of the violation of graves from superstitious motives. Thus in March, 1896, a peasant died in the village of Penkuhl; soon afterward his son was taken ill of a lingering disease, which the remedies prescribed by the country doctor failed to relieve. It did not take long for the "wise women" of the village to convince him that his father was a "nine-killer," and would soon draw after him into the grave nine of his next of kin. The sole means of depriving him of this fatal power would be to disinter him and sever his head from his body. In accordance with this advice the young man dug up the corpse by night and decapitated it with a spade. In this case the accused, if tried in court, might honestly declare that he acted in self-defense; indeed, he might plead in justification of his conduct that he thereby preserved not only his own life, but also the lives of eight of his nearest and dearest relations, and that he should be commended rather than condemned for what he had done. It is the possibility and sincerity of this plea that render it so difficult to deal with such offenses judicially and justly. Here is needed what Tennyson calls

> "The intuitive decision of a bright
> And thorough-edged intellect, to part
> Error from crime."

Quite different, however, from a moral point of view, is the opening of graves in quest of medicaments, and especially of talismans, which are supposed to bring good luck to the possessor or to enable him to practice sorcery and to commit crime with impunity. In ancient times, and even in the middle ages, physicians sometimes prescribed parts of the human body as medicine, and in Franconia, North Bavaria, a peasant now occasionally enters an apothecary's shop and asks for "*Armensünderfett*," poor sinner's fat, obtained from the bodies of executed malefactors and prized as a powerful specific. The culprit was tried first for murder and then for lard, and thus made doubly conducive to the safety and sanitation of the community. Formerly many persons went diligently to public executions for the purpose of procuring a piece of the criminal as a healing salve, but since the hangman or headsman has generally ceased to perform his fearful functions in the presence of a promiscuous crowd, such loathsome remedies for disease are sought in churchyards.

In May, 1865, a Polish peasant in Wyssokopiz, near Warsaw, discovered that the grave of his recently deceased wife had been opened and the corpse mutilated. Information was given to the police, and a shepherd's pipe, found in the churchyard, led to the detection of the culprit in the person of the communal shepherd, a man twenty-six years old, who on examination confessed that he, with the aid of two accomplices, had committed the disgustful deed. His object, he said, was to procure a tooth and the liver of a dead person. He intended to pulverize the tooth and after mixing it with snuff to give it to his brother-in-law in order to poison him. On perceiving, however, that the body was that of a woman, he did not take the tooth, because it would have no power to kill a man; but he cut out the liver for the purpose of burying it in a field where the sheep were pastured, and thus causing the death of the entire flock in case he should be superseded by another shepherd, which he feared might happen. All three were condemned to hard labor in Siberia.

It is a quite prevalent notion that if any part of a corpse is concealed in a house, the inmates will have the corresponding bodily organs affected by disease and gradually paralyzed. A drastic example of this superstition occurrred in May, 1875, at Schwetz, a provincial town of West Prussia, where a woman named Albertine Mayevski became the mother of a male child, which died soon after its birth. The father, to whom she was betrothed, refused to marry her, and to punish him for this breach of promise she disinterred the body of her babe, cut off its right hand at the wrist and the genitals, and hid them in the chimney of the house of her faithless lover, hoping thereby to cause the hand, with which he had pledged his vow, to wither away, and to render him impotent. All this she freely confessed when brought to trial, and was sentenced to two months' imprisonment. But such relics of the tomb are used, on the principle of *similia similibus*, not only for inflicting injury, but also for bringing luck. Thus members of the "light-fingered craft" carry with them the finger of a corpse in order to enhance their skill, success, and safety in thievery; if the finger belonged to an adroit thief or a condemned criminal its talismanic virtue is all the greater. It is also believed that a purse in which a finger joint is kept will contain an inexhaustible supply of money. The finger of a murdered man is greatly prized by burglars because it is supposed to possess a magic power in opening locks. The records of criminal courts prove that these absurd notions are generally entertained by common malefactors in East Prussia, Thuringia, Silesia, Bohemia, and Poland. A candle made of fat obtained from the human body is very frequently used by thieves on account of its supposed soporific power, since with such a taper, known in Germany as *Diebslicht* or *Schlummerlicht* (sloom-light in provincial English), they are confident of being able to throw all the inmates of the house into a deep sleep, and thus rummage the rooms at will and with perfect impunity. The danger of detection is also forestalled by laying a dead man's hand on a window sill; and in order to make assurance doubly sure, both preservatives are usually employed. Hence the proverbial saying, "He sleeps as though a dead hand had been carried round him." The desire to procure material for such candles often leads to the commission of crime. An Austrian jurist, Dr. Gross, in his manual for inquisitorial judges (*Handbuch für Untersuchungsrichter*), and the folklorists Mannhardt and Jakushkin, give numerous instances of this kind, and there is no doubt that the many mysterious murders and ghastly mutilations, especially of women and children, so horrifying to the public and puzzling to the police, are due to the same cause. In most cases the prosecuting attorneys and judges are unable to discover the read motives of such bloody and brutal deeds because they are ignorant of the popular superstitions in which they have their origin, and, for lack of any better explanation, attribute them to mere brutishness, wantonness, homicidal mania, and other vague and unintelligible impulses, whereas in reality they spring from a supremely selfish but exceedingly definite purpose, are perpetrated deliberately, and with the normal exercise of the mental faculties, and can not be mitigated even by the extenuating plea of sudden passion. Crimes of this sort are of common occurrence not only in the semi-barbarous provinces of Russia, but also in Austria and Germany, justly reckoned among the most civilized countries of Christendom. On January 1, 1865, the house of a man named Peck, near Elbing in West Prussia, was entered during the absence of the family by a burglar, Gottfried Dallian, who killed the maid-servant, Catharina Zernickel, and ransacked the premises in search of money and other objects of value. Before carrying off his spoils he cut a large piece of flesh out of the body of the murdered girl in order to make candles for his protection on future occasions of this sort. The talismanic light, which he kept in a tin tube, did not prevent him from being caught in the act of committing another burglary about six weeks later. During the trial, which resulted in his condemnation to death, he confessed that he had eaten some of the maid-servant's flesh in order to appease his conscience. This disgusting method of alleviating the "compunctious visitings of Nature" would seem to confirm the suggestion of a writer in the *Russkiya Wjedomosti* (Russian News, 1888, No. 359) that the thieves' candle is a survival of primitive cannibalism, distinct traces of which he also discovers in a Russian folk song which runs as follows: "I bake a cake out of the hands and feet, out of the silly head I form a goblet, out of the eyes I cast drinking glasses, out of the blood I brew an intoxicating beer, and out of the fat I mold a candle." It is certainly very queer to find such stuff constituting the theme of popular song within the confines of Christian civilization at the present day, a grewsome stuff more suitable as the staple of Othello's tales

> "—of the cannibals that each other eat,
> The anthropophagi, and men whose heads
> Do grow beneath their shoulders."

In the burglary just mentioned the murder and mutilation of the maid were incidental to the robbery, and probably an afterthought, but there are on record numerous instances of persons being waylaid and killed for the sole purpose of making candles out of their adipose tissue. No longer ago than November 15, 1896, two peasants were convicted of this crime in Korotoyak, a city on the Don in South Russia. Their victim was a boy twelve years of age, whom they strangled and eviscerated in order to make candles from the fat of the caul and entrails. It would be superfluous and tedious to cite additional examples of this outrageous offense against humanity and common sense, for, like the devils that entered into the Gadarene swine, their name is Legion.

A still more disgusting and dangerous superstition is the notion that supernatural powers are acquired by eating the heart of an unborn babe of the male sex, just as a savage imagines that by eating the heart of a brave foe he can become indued with his valor. The modern European cannibal believes that by eating nine hearts, or parts of them, he can make himself invisible and even fly through the air. He can thus commit crime without detection, and defy all efforts to arrest or imprison him, releasing himself with ease from fetters, and passing through stone walls. This horrible practice has been known for ages, and is still by no means uncommon. In the first half of the fifteenth century the notorious marshal of France, Gilles de Laval, Baron of Rayz, is said to have murdered in his castle near Nantes one hundred and fifty women in order to get possession of unborn babes. He was then supposed to have committed these atrocities from lewd motives, and was also accused of worshiping Satan. A mixed commission of civilians and ecclesiastics, appointed to examine into the matter, found him guilty and condemned him to be strangled and burned on October 25, 1440. In 1429, when he was thirty-three years of age, he had fought the English at Orleans by the side of Joan of Arc, and it was probably the desire to acquire supernatural powers in emulation of the maid that led him to perpetrate a succession of inhuman butcheries extending over a period of fourteen years, the real object of which seems to have been imperfectly understood by the tribunal which sentenced him to death.* Löwenstimm cites several instances of this crime. Thus, in

* A full account of the trial is given in a Latin manuscript preserved in the city archives of Nantes.

1577 a man was put to the rack in Bamberg, North Bavaria, for murdering and disemboweling three pregnant women. In the seventeenth century a band of robbers, whose chief was known as "King Daniel," created intense consternation among the inhabitants of Ermeland in East Prussia. For a long time these freebooters roved and spoiled with impunity, but were finally arrested and executed. They confessed that they had killed fourteen women, but, as the unborn infants proved to be female, their hearts were devoid of talismanic virtue. Indeed, they attributed their capture to this unfortunate and unforseeable circumstance, and posed as persons worthy of commiseration on account of their ill luck. One of the strangest features of this cruel and incredible superstition is its persistency in an age of superior enlightenment. Dr. Gross records two cases of comparatively recent occurrence in the very centers of modern civilization: one in 1879, near Hamburg, where a woman, great with child, was killed and cut open by a Swede named Andersen, and another of like character ten years later in Simmering, near Vienna.

An ordeal very commonly practiced in the middle ages to determine the guilt or innocence of any one accused of theft was to give him a piece of consecrated cheese, which, if he were guilty, it would be impossible for him to swallow. Hence arose the popular phrase, "It sticks in his throat." Thus Macbeth says, after he had "done the deed":

> "But wherefore could not I pronounce amen?
> I had most need of blessing, and amen
> Stuck in my throat."

Wuttke states that this custom still prevails in the Prussian province of Brandenburg, where a person suspected of larceny is made to swallow a piece of Dutch cheese on which certain magical letters and signs are scratched. His failure to do so is regarded as conclusive evidence of his guilt. Various other means of making inquest for the detection of crime are in vogue, some of them merely silly, and others mercilessly savage. Thus a mirror is laid for three successive nights in the grave of a dead man. It is placed there in the name of God, and taken out in the name of Satan. It is believed that by looking into such a mirror the person of the thief can be clearly seen. A bull belonging to a peasant not far from Perm, on the Kama, died suddenly. The owner declared that the death of the animal was due to witchcraft, and demanded that all the women of the village should be made to creep through a horse collar in order to discover the hag who had wrought the mischief. This plan was approved by his neighbors, and, although their wives protested against being subjected to the degrading and for corpulent women extremely difficult and even dangerous test, they finally submitted to it rather than remain under the suspicion of practicing the black art. This performance, which is unquestionably a relic of Uralian-Finnish paganism, took place on March 16, 1896. The following instance may serve as an example of the ruthless barbarity to which such delusions often lead: In December, 1874, a South Russian peasant in the vicinity of Cherson missed one hundred rubles and went to a weird woman in order to learn what had become of them. She consulted her cards and declared that the money had been stolen by a certain Marfa Artynov. The man was greatly astonished at this response, because the accused was a highly respected teacher of young children, and had the reputation of being thoroughly honest. Nevertheless, his credulity got the better of his common sense, and with the aid of his neighbors he seized Marfa and carried her to the churchyard, where he bound her to a cross and began to torture her, beating her with a knout, suspending her by her hands, and twisting and tearing her neck and tongue with a pincers. To her cries and entreaties her tormentors coolly replied, "If you are really innocent, what we are doing can cause you no pain!" Many of the persons who offer their services as clairvoyants and seers to a credulous and confiding public, and whose utterances are accepted as oracles, are professional swindlers. Thus a young lady moving in the higher circles of society in Vienna had a valuable set of diamonds stolen. By the advice of a trusted lackey she consulted a woman, who was reputed to have the power of divination, and who informed her, contrary to the strong suspicions of the police, that the theft had been committed, not by any member of the household, but by a stranger. The young lady was so firmly persuaded of the truth of this statement that, although urged by the court to prosecute the lackey, she refused to do so. The evidence against him, however, was so strong that he was finally tried and condemned. The pythoness, who had endeavored to exculpate him, proved to be his aunt and accomplice.

A queer phase of superstition, which in many parts of Europe seriously interferes with the administration of justice, manifests itself in the various means of avoiding the evil consequences of perjury, at least so far as to soothe the pangs of conscience and to avert the divine anger. This immunity is secured in some provinces of Austria by carrying on one's person a bit of consecrated wafer, a piece of bone from the skeleton of a child, or the eyes of a hoopoe, holding a ducat or seven small pebbles in the mouth, pressing the left hand firmly against the side, crooking the second finger, or pulling off a button from the trousers while in the act of swearing, or spitting immediately after taking an oath. The Russian province of Viatka is settled by a people of Finnish origin, the majority of whom have been baptized and call themselves orthodox Christians, while the remainder are still nominally as well as really heathen. When they take an oath it is administered by a pope or priest, and a Russian jurist, J. W. Mjeshtshaninov, describes the method employed by them to forswear themselves with safety. When called upon to take an oath, the witness raises the right hand with the index finger extended; he then lays the left hand in the palm of the right hand with the index finger pointing downward, and by a crisscross combination of the other fingers, which probably works as a charm, the whole body is converted into a conductor, so that the oath entering through the index finger of the right hand passes through the index finger of the left hand into the earth like an electric current. The witness thus feels himself discharged of the binding influence of the oath, and may give false testimony without laying perjury upon his soul.

The superstitions which encourage ignorant people to commit crime are handed down from generation to generation, and have in most cases a purely local character. In other words, the charms and sorceries and other magical arts employed to produce the same results differ in different places, and unless the judges are familiar with these various forms of superstition they will be unable to understand the exact nature of the offenses with which they have to deal, and their efforts to detect and punish violations of the law will be greatly hampered and sometimes completely thwarted.

The subject here discussed has not only a speculative interest for ethnographers and students of folklore, but also, as already indicated, a practical importance for criminal lawyers and courts of justice in the Old World and even in the United States. The tide of immigration that has recently set in from the east and south of Europe has brought to our shores an immense number of persons strongly infected with the delusions which we have attempted to describe. Acts which would seem at first sight to have their origin in impulses of cruelty and brutality are found on closer investigation to be due to crass ignorance and credulity, and, although the ultimate motives are usually utterly selfish, there are rare instances in which the perpetrators of such deeds are thoroughly disinterested and altruistic, and do the most revolting things, not from greed of gain, but solely for the public good. In cases of this kind the most effective preventive of wrongdoing is not judicial punishment but intellectual enlightenment.

A GEOLOGICAL ROMANCE.

By J. A. UDDEN.

A WESTERN naturalist once said that the geology of Kansas was monotonous. In one sense this remark is certainly justifiable, and the same may be said about the geology of some of the other States on the Western plains. The American continent is built on a comprehensive plan, and many of its formations can be followed for hundreds of miles without presenting much variation in general appearance. Occasionally, however, some feature of special interest crops out from the serene uniformity, and the very nature of its surroundings then makes it appear all the more striking. Minor accidents in the development of our extensive terranes sometimes stand out in bold relief, as it were, from the monotonous background. In their isolation from other details such features occasionally display past events with unusual clearness.

Such is the case with a deposit of volcanic ash which has been discovered in the superficial strata on the plains.* It lies scattered in great quantities in a number of localities in Nebraska, Kansas, South Dakota, and Colorado, having been found in no less than twenty counties in the first-mentioned State. It measures from two to fourteen feet in thickness in different localities, and is mostly found imbedded in yellow marl and clay, and has a somewhat striking appearance in the field, due to its snowy whiteness and to the sharpness of the plane which separates it from the underlying darker materials. Many years before its real nature was known it had been noticed and described by Western geologists. Prof. O. T. St. John saw it many years ago in Kansas, where it appeared as "an exceedingly fine, pure white siliceous material," forming a separate layer of several feet, and set off by a sharp line from the buff clay-marl below. His words describe its usual appearance in other places (see Fig. 1).

This ash occurs in several outcrops in McPherson County in the central part of Kansas, where the writer had an opportunity to study it somewhat in detail a few years ago. Some of the features of the dust at this place reveal the conditions under which it was formed with considerable distinctness, and the volcanic episode which produced it appears strikingly different from the dull monot-

* Dr. Samuel Aughey, Physical Geography of Nebraska, 1880. Prof. J. E. Todd, Science, April 23, 1886, and January 8, 1897. E. H. Barbour, Publication No. V, Nebraska Academy of Sciences. J. A. Udden, The American Geologist, June, 1891, and April, 1893. R. D. Salisbury, Science, December 4, 1896. G. P. Merril, Proceedings of the United States National Museum, 1885.

ony of the ordinary geological work recorded in the terranes of the plains. It may be said to consist of angular flakes of pumice, averaging one sixteenth of a millimetre in diameter, and having a thickness of about one three-hundredth of a millimetre. The most common shape of the flakes is that of a triangle, or rather of a spherical triangle, since the flakes are apt to be concave on one side and convex on

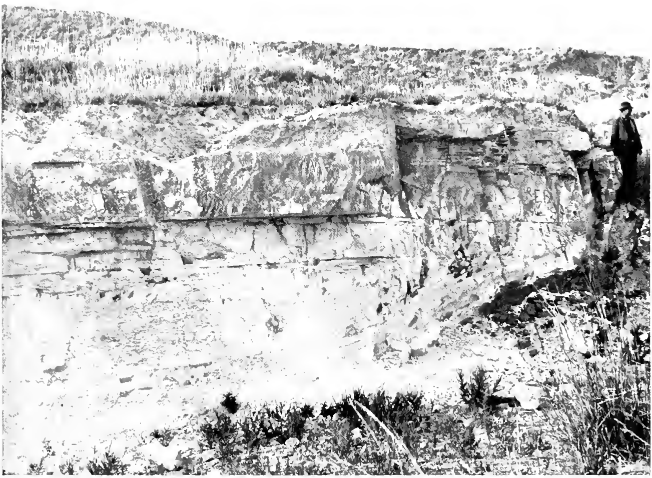

Fig. 1.—Stratified Volcanic Ash near Meade, Kansas.
(From the University Geological Survey of Kansas, vol. ii.)

the other. In the miscroscope they sometimes appear like splinters of tiny bubbles of glass, and this is really what they are (Fig. 2).

The explosive eruptions which give rise to showers of this kind of ash, or dust, are due to fusion and superheating of subterranean masses of rocks charged with more or less moisture. A part of this moisture escapes in the form of steam at the time of an eruption. But the viscidity of the ejected material prevents much of the steam from passing off, and such of the lava as cools most rapidly retains a certain quantity in solution, as it were. Obsidian is a rock which has been made in this way. It often contains much of the original water, which will cause it to swell up into a stony froth when fused.

This volcanic dust has the same property. If one small particle of it be heated on a piece of platinum foil it is seen to swell up into a compound bubble of glass (Fig. 3). It is evident that this is due to the expansive force of the heated included moisture, to which the viscid half-molten glass readily yields. At the time of the eruption which produced this dust, subterranean heat was applied to the moisture-bearing rock until this was superheated to such an extent that the weight of the overlying material was insufficient to hold the water from expanding into steam. Then there was a tremendous explosion, and the molten magma was thrown up with such a force that it was shattered into minute droplets, in the same way as water does when it is thrown forcibly into the air. Being thus released from pressure, the steam inside of each little particle of the heated glass caused it to swell out into a tiny bubble. As this kept on expanding it was cooled, the thin glass wall of the bubble congealed, and finally burst from the pressure of the steam within. This is the reason

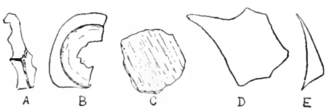

Fig. 2.—Flakes of Volcanic Ash. Magnified about 100 diameters. A, flake with a branching rib; B, fragment of a broken hollow sphere of glass; C, fragment with drawn-out tubular vesicles; D and E, plain fragments of broken pumice bubbles. (From American Geologist, April, 1893.)

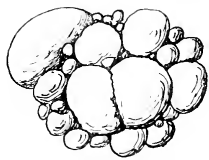

Fig. 3.—A Particle of Volcanic Ash swelled up by Fusion. Magnified 100 diameters.

why the little dust particles are thin, mostly triangular, and often slightly concave flakes with sharp angles. Sometimes the angles appear rounded, as if the fragments had been viscid enough to creep a little after the bubble burst. The study of one single little grain of dust, barely visible to the naked eye, thus makes clear the nature of a catastrophe which must have shaken a whole mountain, and which left its traces over a quarter of a continent.

That the dust was produced in this way is quite evident from other circumstances. If a handful from the dust of this place be thrown into water and gently stirred, it nearly all will settle after a while. But some rather large particles remain floating on the surface. If these are removed and examined under the microscope, they are seen to be hollow spheres (Fig. 2, *b*). These are some of the original bubbles that never burst, either because they contained too little steam or else because the steam was cooled before it had time to break the walls open. It is evident that not every droplet of the molten magma would form a single sphere, but that many also would swell up into a compound frothlike mass of pumice. A few such pieces may sometimes be observed in the deposit at this place, and that many more were made and broken is evident from the great number of glass fragments which have riblike edges on their flat sides (Fig. 3, *a*).

The nature of the force which caused the eruption may thus be understood from the study of one little grain of the dust, but much more extended observations are needed in order to make out the place where the great convulsion took place. It will, perhaps, never be known what particular volcanic vent was the source of this ash. Different deposits may have come from different places. But it seems possible that it all came from the same eruption. There can be no doubt that the volcanic disturbances occurred to the west of the Great Plains. No recent extinct volcanoes are found in any other direction. This conclusion is corroborated by the fact that the dust is finer in eastern localities and coarser nearer the Rocky Mountains. In a bed near Golden, in Colorado, seventy-three per cent, by weight, of the dust consists of particles measuring from one fourth to one thirty-second of a millimetre, while some from Orleans, in Nebraska, contains seventy-four per cent of particles measuring from one sixteenth to one sixty-fourth of a millimetre in diameter. Still finer material comes from the bluffs of the Missouri River near Omaha. Evidently the coarser particles would settle first, and if the dust is finer toward the east, it must be because the wind which brought it blew from the west. Most likely the eruption occurred somewhere in Colorado or in New Mexico.

It may be asked how it can be known that the dust was carried this long distance by the wind. May it not as well have been transported by water? The answer must be, in the first place, that showers of the same kind of material have been observed in connection with volcanic outbursts in other parts of the world. One such shower is known to have strewn the same kind of dust on the snow in Norway after a volcanic eruption in Iceland, and after the great explosion on Krakatoa, in 1883, such dust was carried by the wind several hundred miles, and scattered over the ocean. If this ash had been transported by water, it would not be found in such a pure state, but it would be mixed with other sediments. There would, no doubt, also be found coarser fragments of the volcanic products. On the contrary, it appears uniformly fine. No particles have been found which measure more than one millimetre in diameter, and less than one per cent of its weight consists of particles exceeding one eighth of a millimetre in diameter. In seven samples taken from different places the proportions of the different sizes of the grains were about as follows:

Diameter of grains in millimetres.	$\frac{1}{2}-\frac{1}{4}$	$\frac{1}{4}-\frac{1}{8}$	$\frac{1}{8}-\frac{1}{16}$	$\frac{1}{16}-\frac{1}{32}$	$\frac{1}{32}-\frac{1}{64}$	$\frac{1}{64}-\frac{1}{128}$	$\frac{1}{128}-\frac{1}{256}$
Percentage of weight of each size	0.1	0.1	19	37	32	9	1

Flaky particles of this size are easily carried along by a moderate wind. In some places it appears as if the dust were resting on an old land surface where no water could have been standing when it fell. There is really no room for doubt that it was carried several hundred miles by the wind. It must have darkened the sky at the time, and it must have settled slowly and quietly over the wide plains, covering extensive tracts with a white, snowlike mantle several feet in thickness. What a desolate landscape after such a shower! What a calamity for the brute inhabitants of the land!

Fig. 4.—Tracks in the Volcanic Dust, probably made by a Crawfish. Reduced to 2/3 diameter.

Right here in McPherson County there was either a river or a lake at the time of the catastrophe. This is plainly indicated in several ways. In one place the dust rests on sand and clay, with imbedded shells of fresh-water clams. It is assorted in coarse and fine layers like a water sediment. Lowermost is a seam of very coarse grains. These must have settled promptly through the water, while the finer material was delayed. In another place it lies on higher ground, and here marks of sedges and other vegetation are seen extending up about a foot into the base of the deposit, from an underlying mucky clay. Bog manganese impregnates a thin layer just above the clay, indicating a marshy condition. Here also the material is somewhat sorted, but in a different way. It is ripple-bedded. The water was evidently shallow, if there was any water at all. A burrow like that of a crawfish extended down into the old clay bottom. On a slab of the volcanic ash itself some tracks appeared (Fig. 4). These were probably made by an individual of the same race in an effort to escape from the awful fate of being buried alive like the inhabitants of Herculaneum and Pompeii.

The shower must have lasted for a time of two or three days. I infer this from the nature of the wind changes, which are indicated by the ripples in the dust. These still lie in perfect preservation (Fig. 5), and may be studied by removing, inch by inch, the successive layers from above downward, for it is evident that as the direction of the wind changed, the ripples were also turned. The deciphering of this record must be made backward. The bottom layers were deposited first, and the excavation must begin on top. Otherwise the record is as perfect as if it had been taken down by an instrument when the shower occurred. It may be only local in its significance, for it shows the direction of the wind at this particular place alone. The wind may have been somewhat deflected from the general direction by local topographic peculiarities, though these appear to have been of small importance. In any case, the old legend is quite interesting to read, being, I believe, the only geological record ever found of the passing of a cyclone over the United States.

Fig. 5.—Ripple Marks in the Volcanic Dust. Reduced to ¼ diameter.

In the lowermost foot of the deposit no ripple marks can be seen. But there appear some marks of sedges and other vegetation, and these are inclined to the west, as if the plants had been bent by an east wind. Just above the height to which the imprints of the vegetation extend, ripple marks begin to appear, running on a northeast-southwest course. They were made by a southeast wind, for their northwest slopes are the steeper. A little above this height some peculiar small elevations appear on one of the bedding planes, and slightly raised ridges run for a short distance to the northeast from

Fig. 6.—Peculiar Elevations caused by a Current from the Southwest to the Northeast. Reduced to ½ diameter.

each elevation, vanishing in the same direction (Fig. 6). A southwesterly current was unmistakably obstructed by the little elevations, and left the small trails of dust in their lee. Six inches higher up the wind comes more from the south, and for the next foot the ripples continue to gradually turn still more in the same direction so as to at last record a due south wind. At this point it suddenly changed and set in squarely from the west, for the ripples are turned north and south, with the steeper slopes to the east. This direction seems to have prevailed as long as the dust kept on falling. It appears to me that these successive changes are best explained as attendant upon the passage of a cyclone, or of what our daily weather maps call a "low area." Going by from west to east, on the north, it would at first cause an east wind. This would then gradually be turned to the south and then to the west. One such rotation of the wind generally lasts a day or two. The shower must then have kept on at least for the same length of time, if not longer (Fig. 7).

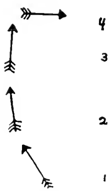

Fig. 7.—Changes in the Wind as recorded by the Ripple Marks.

There is reason to believe that this catastrophe occurred in summer. No crayfish would be out making tracks during the cold months, and the fossil vegetation could hardly have left such plain marks if it had been buried by the dust during the winter. The most conspicuous of these marks are some triangular and V-shaped molds of the stems and leaves of sedges. Siliceous skeletons of *chara* and filamentous algæ were also found upon a close examination in some of these molds.

It is really difficult to appreciate the change such a shower must have produced in the appearance of the landscape, and the effect it must have had on animal and plant life. So far away from the volcanic source, the wind can not have laid down a layer of this dust several feet in thickness without scattering it far and wide all around. It must have covered tens of thousands of square miles. Just imagine, if you can, a whole State, clad in the verdure of summer, suddenly, in two or three days, covered over by a blanket of white volcanic ash! Many species of plants must have found it impossible to grow in such a soil. And what disaster it must have caused in the animal world! Grazing herds had their sustenance buried from their sight, and could save their lives only by traveling long distances in this loose dust. Many a creature must have had its lungs or its gills clogged with the glassy flakes floating in the water and in the air. The sudden disappearance of several mammal species near the beginning of the Quaternary age has been noted by paleontologists. Does it seem unlikely that an event like this, especially if repeated, may have hastened the extermination of some species of land animals? That many individuals must have perished there can be no doubt. Not very far away from that outcrop of the dust which I have described, one of the early settlers in this part of the State once made a deep well that penetrated the ash. Above the deposit, and some sixty feet below the surface of the prairie, he found what he described as "an old bone yard." In digging other wells in this vicinity mammal bones have been taken up by the settlers from about the same horizon. It is to be regretted that, with one exception, none of these fossils have been preserved for study, for it is likely that they were the remains of animals which were killed in the dust shower.

In the absence of fossils definitely known to be connected with the ash, its exact age seems yet uncertain. In McPherson County it is underlaid by clay, gravel, and sand, which contain remains of the horse, of a megalonyx, and of bivalve mollusks of modern aspect. In the bluffs of the Missouri River near Omaha pockets of a similar ash rest on glacial clay under the loess. At the latter place it must belong to the Pleistocene age, and at the former it can not be older than the late Pleiocene. These two deposits may not belong to the same shower, but it appears, at any rate, that the volcanic disturbances which produced them occurred near the beginning of the Pleistocene age.

In comparison with the slow and even tenor of the routine of geological history, the event here sketched appears so unique and so striking that it may well be called a geological romance. Modern science has taught us that the geological forces are slow and largely uniform in their work, and that most of the earth's features must be explained without taking recourse to theories involving any violent revolutions or general terrestrial cataclysms. While the making of this dust is not any real exception to the law of uniformity, we are here reminded that Nature is quite independent in her ways, and that even in her sameness there is room for considerable diversity.

Mr. William Ogilvie, of the Topographical Survey of Canada, estimates that there are more than 3,200 miles of fair navigation in the system of the Yukon River, of which Canada owns nearly forty-two per cent. A remarkable feature of the river, with its Lewes branch, is that it drains the Peninsula of Alaska and nearly cuts it in two, starting as it does less than fourteen miles, "as the crow flies," from the waters of the Pacific Ocean, at the extreme head of the Lewes branch, whence it flows 2,100 miles into the same ocean, or Bering Sea, which is a part of it. The drainage basin of the river occupies about 388,000 square miles, of which Canada owns 149,000 square miles, or nearly half, but that half is claimed to be the most important. As for the origin of the name Yukon, the Indians along the middle stretches of the river all speak the same language, and call the river the Yukonah: in English, "the great river" or "the river." The Canadian Indians in the vicinity of Forty Mile call it "Thetuh," a name of which Mr. Ogilvie could not learn the meaning. The correct Indian name of the Klondike is *Troandik*, meaning Hammer Creek, and refers to the barriers the Indians used to erect across the mouth of the stream to catch salmon, by hammering sticks into the ground.

THE SEASON OF THE YEAR.

By GRANT ALLEN.

A YEAR is, roughly speaking, the period which it takes the earth to perform one complete revolution round the sun. I say "roughly speaking" with due humility, having the fear of the expert ever before my eyes, because I know that if I do not sing small, that inconvenient person, the astronomical critic, will come down upon me at once like a wolf on the fold, with minute distinctions about the mean, the tropical, and the sidereal year; matters of immense importance at Greenwich Observatory, no doubt, but elsewhere of very little interest indeed, seeing that they differ from one another by so many minutes only. Let us leave the astronomers their own problems. The year with which I am going to deal humbly here is a much more commonplace, ordinary, and comprehensible year—the visible year of vegetation, of plant and animal life, of the four seasons; the year as roughly known to children and savages, and to the weeds, the flowers, the bees, and the squirrels.

It has often struck me as curious that people took this complex concept of the year so much for granted—inquired so little into its origin and discovery. Yet it is by no means everywhere obvious. How did men first come to notice, in the tropics especially, that there was such a thing as the year at all? How did they first observe, save in our frozen north, any fixed sequence or order in the succession of Nature? How did they learn, even here, that spring would infallibly follow winter, and summer be succeeded in due course by autumn? And, to go a step farther back, how did the plants and animals, in all parts of the world alike, come originally to discover and adapt themselves to all these things? How did the bee know that she must "gather honey all the day from every opening flower," the summer through, in order to use it up as bodily fuel in winter? How did the plants learn when to blossom and produce seed? In one word, how did the seasons come to be automatically recognized?

That they *are* automatically recognized, even by plants, quite apart from the stimulus of heat or cold, drought or rain, a single fact (out of many like it) will sufficiently prove. Trees brought from Australia to England, where the seasons are reversed, try for two or three years to put forth leaves and flowers in October or November—the southern spring. It takes them several autumns before they learn that the year has been turned upside down—that June is now summer and December winter. This shows that life moves in regular cycles, adapted to the seasons, but not directly dependent upon them. The rhythm of the world has set up an organic rhythm which now spontaneously and automatically follows it.

At first sight, to the dweller in the temperate zone at the present day, the questions I have put above may seem needless, not to say childish. But that is perhaps because we have all too much the habit of taking it for granted that what is true here and now has also been true everywhere and always. A first visit to the tropics often enough rudely disturbs this uninquiring attitude of mind. For in the tropics, and especially in the equatorial region, there is no winter and no summer, no spring and no autumn. The world wags wearily through an unending display of monotonous greenery. As far as temperature goes, the year is pretty much alike in all its months. Yet not only do equatorial men recognize the existence of the year as a natural epoch quite as much as other men—not only do equatorial savages celebrate annual feasts, count ages by years, and perform certain rites in certain months only—but also animal and vegetable nature recognizes the year; trees have their month for blossoming and fruiting, birds their month for assuming the plumage of courtship, for nesting and hatching, almost as markedly as elsewhere. The recognition of the year both by man and by Nature is not therefore entirely dependent upon the difference of summer and winter, as such. We must go deeper, and I think, when we come to consider geological time, much deeper, if we wish to understand the true character of yearliness—a word which I venture here to coin to express this meaning.

Have you ever quite realized what the tropical year is like? Suppose you are living on or near the equator, then in December the sun is south of you and at its greatest distance away; you have, so to speak, a relative winter. But in March the sun is overhead; it is now full midsummer. By the end of June the sun has gone north, and is once more on a tropic; you have a second winter; not much of a winter, I admit, but still, a relative winter. By September he has returned overhead again, and you are enduring a second summer. In December he has once more retreated to the southern tropic (Capricorn), and it is comparative winter. Thus the equatorial year consists of four distinct seasons, in two of which the sun stands directly overhead, while in two he is at his northern or southern limit. I may add that the effect is always curious when, as you face the sun, you see that he is moving in his diurnal path, not from left to right ("the way of the sun," as we say), but from right to left (or "widdershins"). You are never till then aware how natural and inevitable has seemed the opposite direction: when you find it reversed the effect is surprising.

Now, the distance to which the sun travels north or south of you, if you live on the equator—I use ordinary terms instead of astronomical ones for simplicity's sake—is so comparatively small that within the tropics themselves you never notice much difference as to the amount of heat between one period of the year and another. In equatorial countries the day and night temperature is much the same all the year round: if the country be plain, it is always hot; if mountainous, like the district about Bogotá, it is "a perpetual spring"; one day is always much the same as the one that went before and the one that comes after it. Even on the actual tropics, again, the difference is too slight to make any marked change in the temperature; people living on the northern tropic (Cancer), for example, have the sun vertical to them on June 21st, and some forty-three degrees south of them on December 21st. Nevertheless, the sun is still as near them and as powerful as he is at Milan or Venice in the height of summer; and the consequence is that, as a matter of fact, the thermometer within the tropics and at sea level seldom descends below 75° or 80°, even at midnight in the relative winters. For the heating power of the sun depends, of course, upon the directness of his rays, and lessens with their obliquity; in Venice and Milan they are strong enough to make the ground very hot in July and August, though it has been cooled before by a northern winter; much more than in Jamaica or Madagascar, which have never been cooled, does the accumulated heat keep everything warm even when the sun is most oblique—and he never reaches the same obliquity as in an English summer. The ground is hot, the houses are hot, wood and stone are hot, and they have all been hot from time immemorial.

Yet tropical and equatorial trees and plants have their definite seasons to flower and fruit, just the same as elsewhere. This seems surprising at first when one visits the tropics. You can not see why everything should not flower and fruit the whole year round. And yet, at one time pineapples are "in," at another mangoes. And these seasons differ in the northern and southern hemispheres; what is mango winter in the one being mango summer in the other. I do not say the seasons anywhere in the tropics differ markedly; still, they do differ; the tropical year is divided into times and months for agriculture just as much as any other. Thus there are regular dates in each hemisphere for planting, tending, and cutting the sugar cane. Now, what is the reason of these changes in vegetation, when temperature remains so constant? Why do not trees and shrubs of each kind flower up and down throughout the year irregularly—now one individual and now another? Why are there seasons for things at all in the tropics?

The answer is, because the same causes which produce summer and winter in temperate climate produce other changes of other sorts in the tropical region. The temperature, it is true, remains the same, or approximately the same; but the meteorological conditions vary. Even with ourselves, summer is not only hotter but also drier than winter; winter is marked by rain and snow as well as by lowered temperature. In the tropics, on the other hand, it is rather the summer or summers that are wet, for there is a certain moving zone of equatorial calms in which it practically keeps on raining always. But this zone is not fixed; it flits with the sun. When the sun goes northward for the northern summer the rainy zone goes with him; when he turns southward again the zone shifts after him. Thus places on or near the two tropics have one rainy season a year, while places on the equator have usually two. The intervening dry seasons are often very dry and parched, indeed; and where this is markedly the case, the rainy season acts just as spring does in the north, or as the inundation does in Egypt; it is the beginning of vegetation. The plants that were dry and dormant during the arid months wake up into fresh life; the branches put forth new leaves; the brown seeds germinate; the flowers appear; and in due time the fruit ripens. Everything in these cases depends upon the recurrence of the rainy season, just as everything in India depends upon the bursting of the monsoons, and everything in Egypt on the rising of the Nile. I have seen a dry plain in Jamaica bare and brown one day, and covered six or eight inches high with fresh green waving guinea-grass the day but one after. The rains had came meanwhile, and Nature had awaked with more than springlike awakening. In those hot climates everything grows by magic as soon as it gets the needed water.

Indeed, we may say that in half the world the seasons, organically speaking—I mean, the seasons of plant and animal life—depend upon heat and cold, summer and winter, snow or sunshine; but in the other half they depend almost entirely upon drought and rainfall. Even as near home and as far north as Algeria, the summer is far too dry and dusty for agriculture; the autumn rains set in about October or November; they are immediately followed by the plowing; and the winter becomes for most purposes the practical summer. Fruits and vegetables are at their best in January and February; the fields are full of flowers up to March or April; in June, July, and August the country is an arid and weary desert. But the seasons for dates are almost reversed; they ripen in autumn. In Egypt again, where everything depends upon the inundation, the seasons are still more complicated; the inundation begins to subside in October; in Upper Egypt the winter season which follows is far the most important for agriculture, and crops sown as the water subsides are reaped from four to seven months after. But in the Delta, rice, cotton, and indigo are sown in the spring (March or April) and harvested in October, November, and December. Here, irrigation and temperature come in as disturbing elements, for the Delta feels something of the cold of winter.

I could give many other instances, but these will suffice. As a general rule, we may say that in the temperate and frigid zones the seasons for plants and animals are ruled by heat and cold, but that in tropical and even in subtropical climates, rainfall and drought, themselves largely due to the same circumstances, are the ruling factors.

Again, everybody knows that winter and summer, and the other phenomena which simulate or accompany them, such as wet and dry seasons, depend upon the fact that the earth's axis is not perpendicular to the plane in which the earth moves round the sun, but slightly inclined to it. Now, a year in itself, viewed as a measure of time, is merely the period which it takes the earth to perform one such complete revolution. During one half of each such revolution the north pole is turned at a considerable angle toward the sun, and during the other half, the south pole. When the north pole is so turned we call it summer in the northern hemisphere; when the south pole is being favored, and the north is receiving less light and heat, we call it winter. Let us suppose for a moment that the earth had not got this twist or kink in its axis; that the equator was always presented exactly toward the sun; what then would happen? Obviously, there would be no change of seasons. The day and night would have fixed lengths which never varied; climate would in each place be uniform and, barring accidents of elevation or distribution of land and water, the climate of each place would also depend entirely the whole year round on its distance from the equator. Roughly speaking, the temperature of a district would be the temperature it now possesses in March and September, only not quite so cold as March nor so warm as September, owing to the absence of accumulated heat from summer or of reserves of ice and snow from winter. In one word, under such conditions there would have been climates—marked belts of climate; but there would not have been seasons.

Seasons, however, depend in great part, as Mr. Alfred Russel Wallace has ingeniously shown, on a great many things besides this mere inclination of one end or the other of the earth toward the sun in June and January. Much must be laid to the count of accumulated stores of heat or cold; and though accumulated cold is physically a misnomer, still for all practical purposes we may apply the words fairly enough to the ice caps of the pole and the glaciers of mountain systems. And here we come face to face with the very core of our problem: for the odd part of it is that seasons (at least as we know them) seem to be quite a recent and exceptional phenomenon in the history of our planet. So far as we can judge, geologically speaking, the earth during all its earlier life enjoyed, over all its surface, what we should now consider tropical or subtropical conditions. England—or rather the land that occupied the part of the earth's crust where England now stands—had a vegetation of huge tree ferns and palms and cycads during the Primary period; as late even as the middle Tertiaries it had a vegetation like that of South Carolina or Upper India. Greenland itself, in quite recent times, flourished like a green bay tree, and did not belie its odd modern name. The world as a whole enjoyed perpetual summer. In one word, except in something like the equatorial sense, there were practically no seasons. The sun went north and south, no doubt, as now, but the temperature, even in the relative winter, seems to have remained perennially mild and genial.

It is true, occasional slight traces of glacial epochs, earlier than the great and well-known Glacial epoch, break here and there the almost continuous geological record of palmy and balmy world-wide summers; yet, taking the geological monuments as a whole, they show us few or no signs of anything worth calling a serious winter till quite recent periods. Large-leaved evergreens are still, in the day-before-yesterday of geology, the order of the day; magnolias and liquidambars, cinnamons and holly oaks, vines and rotang palms formed the forests even of Miocene Britain. The animals during all the Tertiary period were of what we now regard as tropical or subtropical types—lions, rhinoceroses, hippopotamuses, monkeys, or more antique races, equally southern in aspect. There could have been little change of winter and summer during this long warm spell; the variations can have been scarcely more than those of dry and rainy seasons. The trees never lost their leaves; the fruits and flowers never ceased to follow one another; no interruption of the food supply drove insects to hibernate in their silken cocoons, or squirrels and bears to lay by stores of food or fat for the cold and hungry winter.

Nevertheless, taking the world round as it stands, we must believe that the distinction of seasons grew up, both for plants and animals, and for man or his ancestors, during this age of relatively unmarked summers and winters. For the tropics more than anywhere else preserve for us to-day the general features and aspect of this earlier time; they have never had the continuity of their stream of life rudely interrupted by the enormous changes of the Glacial epoch. Yet, even in the tropics, things, as we saw, have seasons.

There are annuals and perennials there, as elsewhere. Each kind has its month for sprouting, for flowering, for fruiting, for shedding its seed; and men in the tropics, some of them long isolated in oceanic islands, or in great insulated regions like Australia or New Guinea, from the rest of their kind in the temperate regions, nevertheless know and observe the year, and perform all their functions, agricultural or religious, by yearly cycles. For example, there is among them all an annual feast for the dead, and widows mourn their husbands for one year from their burial. Observation of the year, therefore, both automatically by organisms at large and consciously by man, antedates and is independent of observation of the existence of summer or winter.

I do not think, however, that man would have noted the merely astronomical year—the year of the sun's position—at least till a relatively late stage in culture, if he had not first noticed the organic year—the regular recurrence of plant and animal seasons. So many yams—that is to say, so many yam harvests—in other words, so many years, is a common savage way of reckoning times and ages. But they call it "yams," not summers or winters. And when I say yams, I give that merely as a single instance, for elsewhere the "seed-time and harvest" are reckoned indifferently in maize or millet, rice or barley, according to the agriculture of the particular people. Even hunting races know that at certain times of year certain foods abound; and this is true of equatorial savages and equatorial plants or animals, as well as of others.

Moons are more obvious measures of time than suns, in the tropics at least—probably everywhere; for the waxing and waning of the moon mean much to people who live largely out of doors; and the month is, perhaps, the earliest fixed mode of reckoning time beyond a day or two. Most savages count time mainly by so many moons. But they must also have noticed early that after a certain number of moons (usually about thirteen), certain fruits or seeds were ripe again; especially must they have noticed it when this recurrence coincided with the return of the rainy season, or of some other annual meteorological phenomenon, like the bursting of the monsoon or the Nile inundation. Thus, even in the tropics, and before the coming on of the Glacial epoch, men or the ancestors of men (one can not draw precise lines here) must probably have observed a certain rough relation between the months and the vegetative cycles; after so many moons, about say thirteen, the yam, or the mangoes, or the grains are ripe again. These organic years, I take it, must have been noticed before the astronomical ones. For it is now beginning to be more and more believed that man is of preglacial origin; and even if something worth calling a man were not, then at least man's pre-human ancestors go back far into the Tertiary period. Only later would men begin to note that some thirteen moons, and the recurrence of a food stuff, concurred with a particular solar season.

Indeed, if one comes to think of it, how much even now do any of us, save the most scientific, mean by the year, beyond the visible change of summer and winter? What we are thinking of is the leafless trees, the ice and snow, the green grass in spring, the flowers and warm days in summer, not the abstract astronomical fact of the earth's revolution round the sun, or the due succession of the signs of the zodiac. It is that visible organic year that must have counted most with man from the first; though no doubt its meaning and reality are much more vividly present since the coming on of the Glacial epoch, and the more so in proportion as we live nearer to the north or south pole; while at the equator the year is to the last a much more inconspicuous period—a largely artificial mode of reckoning.

Still, from the very first, there was one element of diversity in the year which must have struck all men, in the temperate and frigid zones at least, perhaps even in a certain way in the tropics. I mean, the varying length of the day, always perceptible in the frigid and temperate zones; for as soon as men in these regions began to think and to observe at all, they must have noticed that the days increased in their summer and lessened in their winter; and they must have learned to correlate this waxing and waning of the day with the appearance or abundance of certain fruits, seeds, birds, fishes, game, roots and other food stuffs. It is at least certain that all the world over men do now celebrate the solstices and the equinoxes as special feasts; and the close similarity in most such celebrations leads one to suspect that the custom has been handed down from the very remote time when the human family was still a single continuous body.

In the tropics, it is true, the days vary so little that this difference in itself is not likely to have struck primæval man. But there, another point would come in—the annual movement of the sun overhead from south to north and *vice versa;* and though this would be less directly important to human life than in temperate regions, it would still be indirectly important. It would bring the rain with it. In Europe, of course, and in temperate America, we can see at once that the return of the sun northward must always have meant spring, the increase of food stuffs, the promise of corn or maize, the suggestion of harvest; and we can therefore understand why the midwinter feast, when the sun after his long journey south begins to move visibly north again, should have been both in pagan and

Christian times the great festival of rejoicing for the men of the north temperate region. Day by day they saw the sun recede and the cold deepen; at last, one evening, he sets a little nearer, and they know that he has not deserted them forever. Similarly, the promise made at Yule begins to be realized at that other great feast of the spring equinox, which we still call in England by its ancient heathen title of Easter; the day by that time has got the better of the night, and "the sun dances on Easter Sunday" in commemoration of his completed victory over the combined powers of winter and darkness. In the tropics, on the other hand, the connection is less clear; but even here the shifting of the sun's apparent place is closely correlated with the shifting of the rain zone; and therefore it would not be long (after man was man) before tropical savages began to perceive a constant relation between the movements of the sun to north or south, and the occurrence of the fertilizing rainy season. We must remember that savages, with their improvident habits, are much more dependent upon rain than we are, and that magical ceremonies for breaking up a drought are among their commonest and most universally diffused superstitions.

On the whole, then, before the coming on of the Glacial epoch, we may be pretty sure that plants and animals on the one hand had learned organically and automatically to recognize the existence of the year and to adapt themselves to it; and that men or the progenitors of men on the other hand had also learned to correlate the recurrent seasons of food supply with the movements of the sun, though nothing equivalent to winter and summer as we know them to-day existed as yet on any part of our planet. I say advisedly "on any part of our planet," because even near the pole itself remains of a subtropical vegetation in Tertiary times have been amply indicated. Nevertheless, in all parts of the world then, as in the tropics now, we may gather that plants and animals ran through annual cycles—that the year, as I have put it, was organically recognized. Trees had their time to sprout, to bud, to flower, to fruit, to seed, to shed their leaves (in the evergreen way); birds had their time to nest and hatch out their young; insects had their fixed periods for laying, for larval life, for assuming the chrysalis form, for becoming winged beetles or bees or butterflies. In one word, the year is a terrestrial reality, not merely an astronomical fact, in the tropics now; it was a terrestrial reality over the whole planet in the Tertiary period. But it was hardly more marked, apparently, into distinct seasons than it is marked to-day in the equatorial region. Rainfall and drought must have had more to do in determining the annual cycles than winter and summer.

From all this it must result that the conception of the year as an epoch at all (save for advanced astronomy) is almost or entirely due to that tilt of the earth's axis which causes the seasons—dry or wet, cold or hot. Without the seasons, in one form or other, we might have been ages longer in discovering the fact that the earth moved round the sun, and that some three hundred and sixty-five days (I omit those important fractions) were needed for its revolution. Certainly, without the seasons, at least to the extent that they occur in the tropics, plant and animal life could hardly have assumed its fixed annual cycles, nor could early men have caught at the idea of the year at all as a period of time, a unit of measurement.

Before the Glacial epoch, in particular, the discovery of the year, organically or consciously, must have been much more difficult than it is now in high latitudes. It must have been almost as difficult in what are now the temperate zones as it is to-day in the tropics. Far north or south, of course, the length of the day would tell; and within the Arctic and Antarctic Circles the long night would form an unmistakable feature. But if the plane of the equator had always found itself vertical to the sun, there could have been no recognition of the year at all, either organic or conscious. In other words, from the point of view of organic life, the year does not mean the revolution of the earth round the sun: it means the apparent northward and southward movement of the sun on either side of the equator; it means the seasons, whether recognized as winter and summer, or as dry and wet periods. That is really the year as man knows it, as plants and animals have always known it.

With the coming on of the great cold spell, however, the importance of the seasons in the temperate and frigid zones, perhaps also even in the tropics, became much more marked. I will not go here into the suggested reasons for that vast revolution, perhaps the greatest our planet has ever suffered. Most physicists now accept more or less the theory put forward with great ingenuity by Mr. Croll, which sets it down to a period of extreme eccentricity in the earth's orbit; but some weight must also be allowed, as Mr. Alfred Russel Wallace has clearly shown, to the local arrangement of land and water on the globe at the time of its origin, as well as to the occurrence of mountain ranges just then at the poles, and to other purely terrestrial causes. Never before, in all probability, had the poles been occupied by great glacier-clad mountains. It seems most likely, indeed, that we are now practically at the end of the Glacial epoch, and that if only we could once get rid of the polar ice caps, which keep a stock of chilliness always laid on (I speak the quite comprehensible language of everyday life), we might recur forthwith to the warm and almost imperceptible winters of the preglacial period. But, as things stand, the stock of ice at the poles never gets melted away in the existing northern or southern summer; fresh ice accumulates on top of the old mass with each winter; prevailing winds, blowing over this ice, chill regions lying much farther toward the tropics; icebergs detach themselves and float off, thus lowering the temperature of the sea in the middle zones; arctic or antarctic currents spread round the coasts and absorb the solar heat in enormous quantities. We have only to remember the trenchant difference in England between a parching cold east wind and a mild sou'-wester to realize what an immense part these polar ice caps and frozen highlands play in the production of our existing winter. Alps, Pyrenees, Himalayas, Rocky Mountains, further assist in the same direction.

On the other hand, currents in the sea may cut either way; the Gulf Stream makes England warm, while the arctic current makes Labrador, much farther south, practically uninhabitable.

Ever since the Glacial epoch, therefore, it has been quite easy for man in the temperate and frigid zones to recognize the year as a natural reality. The annual cycles of heat and cold are far too marked to be overlooked by anybody. Organically, they made themselves felt at once by extraordinary changes induced in the fauna and flora. Before the steady advance of the annual cold wave, vegetation had perforce to alter its ways. The large-leaved evergreens went out altogether in frigid and high temperate regions; deciduous trees, or needle-leaved types like the pines and firs, took the place of the luxuriant Miocene foliage in Europe and North America. Every autumn the larger number of trees and shrubs learned to shed their leaves all togeher; every spring they came out anew in fresh green and in masses of blossom. Similarly with animals. Birds learned to migrate, or to accommodate themselves to the winter; insects learned to hibernate in the egg or the cocoon; pigs fattened themselves on mast against the frozen time; moles slept over winter; squirrels hoarded nuts for a store to bridge over heavy frosts; frogs retired to the warmer mud in the depths of ponds; adders coiled themselves in holes and dozed away the cold season. Innumerable adaptations sprang up at once, those species or individuals which failed to meet the new conditions perishing in the struggle. In proportion as we recede from the tropics, the more marked do the annual cycles of life thus induced become, many species practically ceasing to exist as such for several months of the year, and being only potentially represented by eggs, germs, or seeds, and sometimes by dormant pregnant females.

At the same time, while the cause of the seasons as a whole is the obliquity of the earth's axis, with the resulting inclination of either pole toward the sun alternately, we must not forget that the seasons and the climate in each particular country depend in part upon many minor contributory causes. It is not merely nearness to or distance from the equator that counts; we have to consider also relative distribution of land and water, elevation, prevalent winds, exposure, condensation, and many other elements of a complex problem. In Ecuador, for example, whose very name means the equator, the plain is always in scorching summer, the mountains are always in perpetual spring. The monsoons, again, produce in other countries some curious results: they depend themselves on the change of relative temperature in sea and land at different seasons; and they break upon the Himalayas with this odd and unexpected effect, that the snow line on the southern side of that vast range goes very far down, owing to the immense rainfall (or rather snowfall) and the consequent spread of snow fields and glaciers; while on the northern side it descends but a very little way, owing to the extreme desert drought and the great summer heat of the central Asiatic table-land. We have thus the apparent paradox that millions of Tibetans occupy towns and cultivate farms to the north at a height from three to four thousand feet above the snow line on the southern slope of the same mountains.

Looking at the matter broadly, then, and taking for granted the now generally accepted modern view that the great oceans and great continents have been relatively fixed (though liable to minor fluctuations and variations of outline) throughout all geological time, and that the earth's crust has not shifted from pole to equator or *vice versa*, we arrive at last at the following probable conclusions: There have always been seasons more or less marked, and these have been more or less organically answered by corresponding changes or cycles of change in plants and animals. Rain and drought have in many cases more to do with such changes than variations of temperature. The seasons, again, are less marked in the tropics than in temperate and circumpolar climates. Nevertheless, even near the equator, they exert and have always exerted certain organic influences—have resulted in annual cycles in the life of species. Even before the coming on of the Glacial epoch, the seasons were probably somewhat more marked in the temperate and polar regions than in the tropics, the longer day in summer and the greater directness of impact of the rays making the summer months always warmer. But for various reasons, among which we may presumably rank the absence in early ages of high land at the poles and of an accumulated polar ice cap, together with the existence of warm sea currents from the tropics to the poles, the winters of preglacial ages seem to have been relatively mild, perhaps (if we may judge by the types of plant life) milder than those of South Carolina and Georgia in our own period.

No cold winds of importance seem then to have blown with blighting effect from glaciated or snow-clad districts. (Mars in our own time appears to enjoy winters somewhat of this character, though a little colder, with a temporary snow cap.) The seasons as we know them in temperate and arctic climates, however, seem to be largely the result of the glacial epoch, and its persistent legacy the arctic and antarctic ice caps. If we could once manage to get rid of those, it is possible that our planet might again enjoy in all its zones the mild and genial preglacial winters.

These are rough notes, I know; mere adumbrations of a probable truth: but adequately to develop the subject would require a very big volume. My object here is simply to suggest that in many inquiries, both into human and animal or vegetable life, we must never take the existence of seasons as we know them for granted, except in very recent times. The year, for organic beings, means essentially the seasons; and the seasons may mean and have meant many separate things, as time and place vary—heat and cold, food and scarcity, foliage and leaflessness, drought and wet; longer or shorter days, the midnight sun and the winter darkness; hibernation and wakefulness; the egg, the cocoon, the seed, the plant, the flower, the fruit; dormancy or vitality. According as human life started at the poles or the equator, for instance, it would view in the beginning many things differently. All I wish to point out now is merely this, that we must bear such possibilities ever in mind; and that we must never take it for granted in any problem, human or biological, that the seasons were always just what we know them, or that the year to any organic being meant anything more than the seasonal cycle then and there prevalent.—*Longman's Magazine.*

In the excavations of the ancient cemetery of Antinoe, near Lyons, France, a "party dress" of the time of the Emperor Adrian, very fine silks, jewels. etc., have been discovered. One sarcophagus held the remains of a woman musician with a rose chemise, a cythara, pearls, castanets, etc.; in another was a child's costume with its little laced shoes, its vest ornamented with flowers *appliqués*, and its robe of gauffered crape. It appears that the women of sixteen hundred years ago dyed their hair with henna, and twisted ribbons round their heads. Nothing changes.

M. A. Thieullen, publishing the results of fifteen years' studies among the flint implements of the French beds, draws the conclusions that the elaborate palæolithic flint axe and hammer and the typical neolithic implements were luxuries used by the more distinguished members or for the more important purposes of the flint-implement-using community, while the ruder implements which are found in enormous numbers were the objects of general and daily use throughout all the flint-using ages, whether palæolithic or neolithic.

BRAIN WEIGHTS AND INTELLECTUAL CAPACITY.

By JOSEPH SIMMS, M. D.

HAVING been for thirty years a lecturer on man and his character as evinced by his form, features, head, and gestures, and having made observations on the subject in all parts of North America, in continental Europe and Great Britain, and parts of Asia, Africa, and Australia, I should not be deemed presumptuous when I present a few facts regarding the relations of mind and the size and forms of heads and weights of brains. It has been observed by many persons versed in the branches relating to the subject that men with the largest brains are not those of most talent, power, or intellect; but many such have been only ordinary or inferior men, or even idiots; while some men of most powerful and comprehensive minds have had unusually small brains. Esquirol's assertion that no size or form of head or brain is incident to idiocy or to superior talent is borne out by my observations.

After long and careful research in the great libraries and museums of the world, I have collected a table of brain weights of eminent men, along with which are entered, in my original document, the occupation of the subject, age at the time of determination, and the source whence the item is derived. These can not be given within the limits of this article, and only the briefest and most generalized summary of the main features can be indicated. The largest weight of brain in the whole list is that of the Russian novelist Turgenieff, whose brain weighed, at the time of his death, at sixty-five years of age, 71 ounces.* It is a considerable step from him to the next in order, the English mechanician and author, Knight, whose brain weight at the age of fifty-eight was 64 ounces. Then follow the Scottish physician Abercrombie, 63 ounces; General B. F. Butler, 62 ounces; and the Scottish general Abercromby, 62 ounces. Another group of nine, including weights from 58.6 ounces to 54 ounces, includes Jeffrey, Scottish judge and author, Thackeray, Cuvier, George Combe, United States Senator Atherton, Spurzheim, and the Scottish physician Simpson. The next group, 53.6 to 50, is larger, including twenty-one names, among which are Daniel Webster, Agassiz, Napoleon I, the Scottish divine Chalmers, the mathematicians De Morgan and Gauss, the anthropologist Broca, and the generals Skoboleff and Lamarque. The last group, 49.9 to 40 ounces, contains twenty-five names, including those of the philosopher Huber, Grote, Babbage, the anthropologist Bertillon,

* Medical Times and Gazette, London, England, November 17, 1883.

Whewell,* Liebig, Gall, Gambetta, and Bishop, the mind reader. Only one remove from the foot of the list is Gambetta, a man of indisputably high genius and ability, with a brain weighing only 40.9 ounces.†

The table goes to illustrate a general rule which I discovered and published several years ago, that larger brains appertain to natives of colder climates. Dr. John Abercrombie, for instance, was born at Aberdeen, Scotland, on the German Sea, and farther north than any part of the United States. Sir Ralph Abercromby was born in the county of Clackmannan, Scotland, where it is far colder than any part of southern Europe. Lord Francis Jeffrey first saw light in Edinburgh. General Butler was born in Deerfield, New Hampshire. Ivan Turgenieff, with the heaviest brain of all, was a native of cold, inhospitable Russia. Dr. Franz Joseph Gall (brain weight 42.2 ounces) ‡ was born in Würtemberg, in southern Germany, passed most of his life in Vienna and Paris, and, being a student, spent much of his time indoors. Gambetta was born at Cahors, France, of Italian parents. This climatological view of the size of brains is confirmed by a paper, "Crania," of the Philadelphia Academy of Sciences, which gives as the average size, in cubic inches, of the cranial cavities of various nationalities, taking the results of many measurements: Lapps, 102; Swedes, 100; Anglo-Saxons, 96; Finns, 95; Anglo-Americans, 94; Germans, 92; Celts, 88; Malays, 86; Chinese, 85; Tombs of Gizeh, 84; embalmed Semitic, 82; Egyptians, 80; Fellah, 79; Bengalese, 78.

A table of average brain weights of various nationalities, compiled from Topinard's and Manouvrier's works and other standard anthropological publications, illustrates the same tendency toward greater brain weights in colder countries. One of its results is to show that the colder air of the United States produces larger brains in the negroes than the warm air of Africa. The table further shows, in the comparisons of Hindus and African negroes, that the brains are smallest in the warmest countries, irrespective of race or nation; and that the largest average attained is in Scotland, where it is never extremely warm.

The measurement of the cranial cavity is a very uncertain gauge of the size of the brain, for the cerebro-spinal fluid may occupy a large share of the space. Weighing the brain is without doubt the only scientifically certain method of determining its size and mass.

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* Whewell also had "the scalp and skull thick." Brain weighed 49 ounces. The Lancet, London, England, March 17, 1866, p. 280.

† Medical Times and Gazette, London, England, May 12, 1883, p. 525.

‡ London Medical Gazette, London, England, September 13, 1828, p. 478.

Perhaps the most remarkable case in the table of great men's brains is that of Gambetta, who was behind none of his compeers in ability, and yet had the smallest brain of all. The first table of the "Average Weight of the Human Body and Mind," compiled from Dr. Boyd's researches among the sane, which was based on more than two thousand post-mortem examinations, gives 45.9 ounces as the average brain weight of boys from seven to fourteen years of age, and 40.2 ounces as that of boys and 40.1 ounces of girls from four to seven years of age. And this little brain of 40.9 ounces appertained to a man, "a lofty, commanding, mental figure, standing out in bold relief from the crowd of mediocrities which he dwarfs and shadows," the embodiment of the French Republic, who steered it through one of its most perilous crises, "the foremost Frenchman of his time," who "established his claim to be placed in the very front rank of European statesmen," and whose untimely death was spoken of as "nothing less than the sudden extinction of a powerful individual force, one of the most powerful, indeed, of such forces hitherto operating in Europe."

In illustration of the association of large brains with small minds, we have compiled from various sources of recognized authority a list of one hundred and twenty-five persons of ordinary or weak minds, idiots, imbeciles, and criminals, whose brains were generally larger than those of the distinguished men subjects of the preceding notes. Of these, Rustan, an ignorant and unknown workman, appears with a brain weighing 78.3 ounces; * the dwarfed Indian squaw who follows him, of 73.5 ounces;† an illiterate and weak-minded man had a brain of 71.3 ounces; ‡ and a congenitally imbecile person cited by Dr. Ireland, with one of 70.5 ounces.# Another imbecile cited by Dr. Ireland had a brain of 63.2 ounces, and the brain of an idiot with a large head, eighteen years old, who had an idiotic sister, weighed 62.8 ounces. The brain of the idiot, No. 56 of the men in the table, 59.5 ounces, is exceeded in size by those of only five on the list of famous men, while eleven persons recorded as idiots, imbeciles, and children had brains heavier than his. An idiot boy of fourteen years, very malicious, who never spoke, and who nearly killed his sister with a pick, had a brain weight of 57.5 ounces. Thirty men out of three hundred and seventy-five examined in the West Riding Asylum gave brain weights of 55 ounces and upward, showing that such weights are not so rare as some have supposed. In another

* Brain Weight of Man. By Dr. Bischoff. Bonn, Germany, 1880, p. 137.

† Authority for this weight is the Medical Army Museum, Washington, D. C.

‡ This brain is kept in and its weight is recorded on the glass jar in the Pathological Museum at Munich, Germany.

Idiocy and Imbecility. By Dr. Ireland. London, 1877, p. 75.

asylum in England one out of every dozen brains examined showed a weight of 55 ounces or more.

In *Nachrichten*, of Göttingen, 1860, pp. 70–71, Dr. Rudolph Wagner gave a table of thirty-two persons whose brains he examined, among whom were five distinguished men; but the largest brain weight recorded in it, 55.9 ounces, has opposite to it the legend, "Idiotic grown man."

To this list we might have added a large number of persons whose brains weighed less than 53 ounces. Yet the brains of Daniel Webster, Agassiz, Napoleon I, Lord Byron, Baron Dupuytren, General Skoboleff, and other famous men concerning whose large brains much has been said, weighed less than this; and we might have appended hundreds of brain weights of idiots, imbeciles, and other insignificant persons, from 53 ounces down to 49 ounces—probably about the average weight in central Europe. In support of our contention is, further, an observation by Dr. Rudolph Wagner in *Nachrichten*, February 29, 1860, pp. 71, 72, that "very intelligent men certainly do not differ strikingly in brain weight from less gifted men."

Dr. Clendenning presents in the Croonian Lectures the following entries of brain weights of male subjects of different ages, the tendency of which is to show that the male encephalon loses, after it is grown, more than an ounce every ten years:

15 to 30 years	50.75 ounces.
30 to 50 "	49.66 "
50 to 70 "	47.1 "
70 to 100 "	41.5 "

A number of other eminent anatomists have given similar evidence of decrease in brain weight as intellectual power increases.

The "Professor at the Breakfast Table," the late Dr. O. W. Holmes, a learned man and experienced physician and professor of anatomy in Harvard University for thirty-five years, says: "The walls of the head are double, with a great chamber of air between them, over the smallest and most crowded organs. Can you tell me how much money there is in a safe, which also has thick walls, by kneading the knobs with your fingers? So, when a man fumbles about my forehead, and talks about the organs of individuality, size, etc., I trust him as much as I should if he felt over the outside of my strong box, and told me that there was a five-dollar or a ten-dollar bill under this or that rivet. Perhaps there is, only he doesn't know anything about it. We will add that, even if he knows the inward dimensions of the strong box, he could not thence determine the amount of cash deposited in it."

The internal size of Spurzheim's skull was in cubic inches exactly the same as that of the skull of Joachim, an imbecile six feet nine inches in height, with a brain weight of 61.2 ounces, whereas Spurzheim's brain weighed only 55 ounces.

Whoever has examined heads in the dissecting room of a medical college knows that, except in rare cases of disease, the brain does not fit the skull, but is surrounded by three membranes and a watery fluid; and this liquid, it has been ascertained, is generally sufficient to admit of its performing certain movements.

There can be no doubt that the brain moves in the skull, changing its position, according to the laws of gravitation, in much the same way as the lungs, heart, and liver do in the body. It has been observed many times to move, as well as to pulsate, when exposed to view during the life of the individual. It is subject to two regular and constant motions—one produced by the arteries, the other by respiration. It has also a third motion, discovered and described by Dr. M. Luys, who stated, in a paper read before the Academy of Medicine of Paris, that "the brain is subject to certain changes of position, dependent on the attitude of the body. Thus, if a man lies on his back or side, or stands on his head, the brain undergoes certain changes of position in obedience to the laws of gravity; the movements take place slowly, and the brain is five or six minutes in returning to its previous position." From these anatomical data M. Luys deduced some interesting and practical conclusions, by which he explained, for example, the symptoms of vertigo which feeble persons experience when suddenly rising from a horizontal position. He suggested whether the pains of meningitis may not be due to an interference with these normal movements, and urges the value of giving the brain the change produced by a horizontal position at night.

The average cranial capacity is admitted to be 96 cubic inches in England and 94 in New York; and it is to the unusual quantity of fluid of some cases, and to the extraordinary thickness of the skull in others, that we are to attribute the frequent discrepancy between the external dimensions and the size of the encephalon. Daniel Webster's cranial capacity was 122 cubic inches, yet his brain of 53.5 ounces was just what George Combe has laid down as the average weight for an adult man. Water and lymph, we are told, filled the skull. Professor De Morgan's head, almost free from hair, measured 24.87 inches in circumference, and the dimensions were all those of a very large head, sufficient to contain from 65 to 70 ounces of brain, yet his brain weighed only 52.75 ounces, or little, if at all, above the average in the cold parts of the temperate zones. De Morgan was sixty-five years of age when he died. He was much emaciated, and "the brain was distinctly shrunken," not filling the interior cavity, where its place was supplied, as is usual in such cases, by serum or water. There is no known method whereby any man can determine whether brain or water fills the greater part of any living skull. A small orange may have a thin rind, and contain a good amount of eatable substance, while a large one may have so thick a skin that the fruit proves utterly disappointing.

Another proof that the skull is formed without regard to the brain is the following: "The bony cabinet and its contents are developed, to a certain extent at least, independently. This is very clearly demonstrated by a fact which was observed by Gratiolet, and is too frequently forgotten. The subject is an infant in whom the cranium presented the normal conformation. The brain was, nevertheless, almost entirely wanting." *

Dr. Gall was a poor arithmetician, and his biographer says that every kind of numerical calculation fatigued him. He could not go through a process of multiplication or division that was at all complicated, and knew nothing of geometry or of the problems of mathematics.† George Combe said of himself: "Arithmetic has always been to me a profound mystery, and to master the multiplication table an insurmountable task. . . . This faculty in me is, in fact, idiotic." Again he said: "When a boy, I never could learn arithmetic. At the end of five years' teaching I could not subtract, divide, or multiply any considerable number of figures with accuracy and facility, and can not now do so. . . . At the present day I can not sum a column of figures correctly." ‡

With these facts in view, our wonder at finding the theories of these men at variance with all exact calculation is considerably diminished. We propose to test some of their theories by arithmetical processes. We found that the sixty famous men entered in the table of authenticated brain weights show an average of 51.3 ounces. We now take all the idiots and imbeciles in the table of "Large Brains and Small Minds," and find the average 59.4 ounces; so that the matter is left to stand thus: Ten idiots and five imbeciles average 59.2 ounces; sixty famous men average 51.39 ounces: in favor of idiocy and imbecility, 7.9 ounces.

The heaviest brain in the table of small minds is that of Rustan, an ignorant and entirely unknown laborer. He was a healthy man, and his brain, when it was weighed, was in a healthy condition. Its weight was recorded by Dr. Carl A. Rudolphi, a Swedish naturalist

* The Human Species. By A. De Quatrefages. D. Appleton and Company, New York, 1884, p. 380.

† Dr. Gall's works, Boston, Massachusetts, vol. i, p. 36.

‡ Life of George Combe, London, 1878, vol. ii, p. 381.

and physiologist of Stockholm, who became professor of anatomy and physiology at Berlin in 1810. It reached the unexampled figure of 78.3 ounces; while the brain of Turgenieff, the heaviest among famous men, was 71 ounces—showing a difference of 7.3 ounces in behalf of the inferior mind.

Since writing the above, the following appeared in Tit-Bits, a weekly paper published in London, England, March 19, 1898:

"It must not be assumed, however, that intellect is in direct ratio to the weight of the brain; for while the brains of certain intellectual men, such as . . . Dr. Abercromby, weighed more than 60 ounces, a certain Strand newspaper-boy, who was in intelligence almost an idiot, had a brain which weighed no less than 80 ounces."

Dr. Austin Flint, of New York, in his Physiology, gives the average weight of the brains of men as 50.2 ounces. Dr. Peacock, of Great Britain, makes it 50 ounces 3 drachms between twenty-five and fifty years of age. Dr. Thurman gives 49 ounces as the average throughout Europe, while Dr. F. Tiedemann, a famous naturalist of Germany, reckons it at 53.2 ounces.* Dr. Krause, a learned German, places it still higher, at 55.4 ounces.† Now, if we strike a balance between the highest and the lowest of these estimates, the mean will be 52.2. Then, recalling the average of our sixty famous men, which we found to be 51.3 ounces, it is shown to be nine tenths of an ounce below the average of ordinary men.

Our tables of national average brain weights do not quite agree, because some of the subjects had been wasted by disease for many months before death, whereby the brain was diminished along with other parts of the body. Those who, like Dr. Boyd's subjects, died in hospital, showed too light an average for healthy Englishmen. Dr. Krause's subjects may have been healthy men killed in battle, and those of Tiedemann persons who died suddenly. Executed criminals show a fairly high average of brain weight, because there has been in their case no diminution through long-continued illness.‡ We should recollect that Whewell, the famous English philosopher and head master of Trinity College, Cambridge, England, was in good health when killed by a fall from his horse; so was Gambetta, when his life was ended by a pistol shot. The brain, however, suffers less from the power of disease than the general bodily form. One month under the most wasting sickness would probably not

* Medical News and Gazette, London, June 16, 1888, p. 521.

† Morning Herald, Sydney, Australia, February 23, 1884.

‡ Eleven Chinamen, found by Dr. C. Clapham to afford an average of 50.4 ounces, had been killed in a typhoon, and were therefore in no wise wasted by disease. (Journal of the Anthropological Institute, London, England, vol. vii, p. 90.)

diminish the brain more than an ounce or two, but a year or more would make a considerable difference.

Taking, now, the sixty heaviest brains of persons not noted for intellectual greatness, we find the averages to be 63.2 ounces. Comparing this with the average of sixty famous men, 51.3 ounces, we find a difference in favor of imbeciles, idiots, criminals, and men of ordinary mind of 11.9 ounces. George Combe estimated that about 53.5 ounces was the average weight of the adult brain. Thus the average brain weight of all the eminent men whom we have brought into the comparison, 51.3 ounces, is below Combe's estimate of that of mankind in general. Again, the ten heaviest brains of our list of famous men give an average weight of 61.1 ounces, while the average given by the ten heaviest of the opposite class is 70.4 ounces, or 9.3 ounces greater. While our list of eminent men shows only five whose brains exceeded 58.6 ounces in weight, those of seventy-six of the common throng—seven of them idiots or imbeciles—rise above that figure. These figures augur badly for the doctrine that would attach importance to heavy brains for giving force and depth of individual character.

Phrenologists assert that each organ of a mental faculty occupies a certain position perceptible on the outside of the brain, with a definite area which they have mapped out. They also hold that each of these organs extends to the center of the base of the brain, tapering to it somewhat like a cone, having its base turned toward the outer world. They make no account of the fissures, the intervening sulci and anfractuosities that must cut many of these supposed cones, some at right and some at oblique angles. Then the large, long cavities or ventricles intercept and would hinder many of them from reaching the central, basilar part of the brain. The anatomical structure of the brain thus appears fatal to this theory of the organs.

Large and complicated convolutions of the brain with deep sulci have been regarded by some persons as inseparable from superior powers of mind. The supposition is erroneous and groundless. The rodents, such as beavers, squirrels, rats, mice, etc., have but little brain and no convolutions whatsoever; * yet the beaver exhibits great foresight, economy, industry, and mechanical skill in building his dam, erecting his house, and storing up bark as food for the winter. Moreover, these animals live in societies and labor in union by ingenious methods for a common purpose, with nice judgment. "So great a variety of labors," says Dr. Leuret, "is needed for the constructions carried on by the beaver; they include so many instances of well-made choice, so many accidental difficulties are sur-

* The Nervous System, London, 1834, p. 447.

mounted by these animals, that it is impossible not to recognize in their actions the characteristics of a rather high intelligence." * The sheep has a much larger brain than the beaver, with numerous and complete convolutions, yet it is one of the most stupid of domestic animals. Again, though birds have convolutions in the cerebellum, they have none in the cerebrum, and yet they are more capable of education than any living beings except the human race. The eagle is complete master of the lamb; the magpie, the hawk, the raven, and the parrot with his talking powers, are not excelled in sagacity by the dog, the horse, or the elephant, notwithstanding the latter animals have brains of superior size and elaborate convolutions.

Squirrels manifest foresight and economy in storing nuts for the winter's use; yet they have no brain convolutions. The cetacea, especially whales, have much larger brains than men, with more numerous and more complex convolutions and deeper sulci; yet their intelligence bears no comparison with that of the human race.

Three eminent men are known to have had very small convolutions of the brain—viz., Louis Asseline, Dr. Tiedemann, and Baron von Liebig. We have to add to this remarkable list two, not named, but described by Dr. Wagner as having been very intelligent, who yet possessed very few convolutions in their very small brains.† As Wagner's book was printed before Liebig died, he could not have been one of the two to whom the author referred.

Idiots often possess as large brains as men distinguished for intellectual power, and their brains have as deep sulci, and convolutions as fine, as large, and as complex. Our table of the common and weak-minded contains a mention of an idiot whose brain weighed 53 ounces, or exactly as much as Napoleon's, and had fine convolutions and a large frontal lobe, but who could never learn to speak.

The elephant carries a far larger brain than man, finely formed, broad and high in front, with much more numerous and complex convolutions and deeper anfractuosities, and yet no intelligent person would for a moment claim that its mind excels or even equals that of man.

It may be well here to allow some eminent physiologists to give their views on this subject. "The researches of anatomists have disposed of every point advanced by Gall. Curiously enough, M. Camille Dareste has placed beyond dispute the fact that the number and depth of the convolutions bear no direct proportion to the development of intelligence, whereas they do bear a direct proportion

* Anatomie comparative du système nerveux, tome i, 1839, p. 506.

† Ueber die typischen Verschiedenheiten der Windungen der Hemisphären und über Lehre von Hirngewicht, Göttingen, 1860. Also see Pathology and Therapeutics of Mental Diseases, London, 1870, p. 23.

to the size of the animal. . . . It is notorious that the instinct of propagation, the instinct of destructiveness, the instinct of constructiveness, and other qualities are manifested by animals having no brains, nothing but simple ganglia." *

Dr. Bastian demonstrates the convolutional theory thus: "In animals of the same group or order, the number and complexity of the convolutions increase with the size of the animal. . . . There can not, therefore, be among animals of the same order any simple or definite relation between the degree of intelligence of the creature and the number or disposition of its cerebral convolutions." †

We have the following testimony in our favor from Dr. Rudolph Wagner, of Göttingen: "Examples of highly complicated convolutions I have never seen, even among eminent men whose brains I have examined. . . . Many convolutions and great brain weight often go together. Higher intelligence appears in both kinds of brains, where there are many or where there are few convolutions. It is not proved that special mental gifts go with many convolutions." ‡

Another theory of mind is based on the gray matter of the brain, the amount of which has been supposed to be proportionate to mental capacity. As this gray matter, however, averages only about one fifth of an inch in thickness, it seems rather a thin foundation for the human intellect if the condition is good that "size is a measure of power."

The late Dr. W. B. Carpenter stated the matter thus: "The cortical substance or gray matter of the hemispheres essentially consists of that vesicular nerve substance which, in the spinal cord as in the ganglionic masses generally, is found to occupy the interior. The usual thickness is about one fifth of an inch; but considerable variations present themselves in this respect, as also in the depth of the convolutions." #

Daniel Webster's brain had gray substance to the depth only of one sixteenth of an inch.|| It thus appears that his brain had a thinner layer of gray matter than the average of common-minded men—one among the many proofs that facts are against all theories that connect brain conditions with intellectual power.

Dr. Ireland thus describes an idiot boy who, though thirteen or fourteen years of age, was only three feet eight inches in height: "In expression he was dull and inanimate, with an old face and a short,

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* History of Philosophy, London, 1867, vol. ii, p. 433.

† The Brain as an Organ of Mind, London, 1880, pp. 276, 277.

‡ Nachrichten, Göttingen, February 29, 1860, p. 75.

\# Carpenter's Principles of Human Physiology, London, 1881, p. 659.

|| Edinburgh Medical and Surgical Journal, 1853, vol. lxxix, p. 360.

squat figure. . . . The convolutions were broad and simple, but not shallow. The gray matter was as broad as usual." *

The writer has examined many brains of persons morally or intellectually below the average—such as murderers, negroes, and others sunk in ignorance. He has invariably found the layer of vesicular or gray matter to be thicker than that of Daniel Webster's brain. Elephants, porpoises, whales, dolphins, and the grampus all have this layer thicker than the most intellectual men. Another great objection to locating mind in the gray matter of the brain is that this substance is found in the interior part of the spinal cord, and in all the nerve centers throughout the body; so that, if mind is situated in it, it is not confined to the brain, but dwells in the spine also, and is distributed all through the human frame. Still another objection lies in the fact that wherever the gray matter exists near the surface of the brain, it consists of three distinct layers, separated by a white substance, and the outermost layer is white, not gray.†

The *septum lucidum* consists of gray matter. The *corpus striatum*, situated at the base of the lateral ventricles, nearly in the center of the brain, was from three eighths to half an inch in diameter in an ox which was dissected in Edinburgh. This is about the same amount as is found in the *corpus striatum* of the human brain. There would be lively times if it were possible for a mental faculty to occupy at once all the localities where gray matter is found!

None of the suppositions about certain qualities of mind inhering in particular portions of the brain have been proved, nor have they stood the tests of science.

The theories which have assumed that the cultivation of the intellect gives shape and size to the brain within and consequently to the skull without, advocates of which have not been wanting, have been disproved by the collected facts. "There is no proof," says Dr. J. C. Nott, in his Types of Mankind, "of the theory that the cultivation of the mind or of one set of faculties can give expansion or increased size of brain. The Teutonic races, in their barbarous state, two thousand years ago, possessed brains as large as now, and so with other races."

The St. Louis Globe Democrat of November 13, 1885, gives an account of some excavations on the Mount Ararat farm, east of Carrollton, Illinois, where the bones of thirty-two Indians or mound builders were unearthed. "They were not a diminutinve race, as some people have supposed, some of the thigh bones being sixteen inches long, and some of the skulls twenty-four inches in circumfer-

* Idiocy and Imbecility, London, 1877, pp. 216–219.

† See The Brain as an Organ of Mind, London, 1880, p. 465; also, The Human Brain, London, 1847, pp. 288, 289.

ence." A skull having a circumference of twenty-four inches means a head that measured from twenty-five to twenty-six and a half in life, when the cranium was covered with skin and muscles. The average head of white men in New York to-day is only twenty-two and a half inches round. So the culture of the white race for centuries has not developed their heads to near the size of those of the uncultured mound builders who inhabited America many centuries ago. Our own opinion is that cultivation by means of a thorough classical education, where the appetite is restrained, as usually occurs, tends rather to diminish the size of the head, by reducing the temporal muscles and the adipose tissue under the scalp.

The Engis skull is one of the most ancient known to exist, and belonged to the stone age, or about the same time as the Neanderthal skull. Professor Huxley describes it as being well formed, and considerably larger than the average of European skulls to-day in the width and height of the forehead and in the cubic capacity of the whole.

Quatrefages, in The Human Species, p. 312, says: "This skull (the Engis or Cro-Magnon), so remarkable for its fine proportion, is also remarkable for its capacity. According to M. Broca, who could only work under precautions calculated to diminish the amount, it is equal to at least 1,590 cubic centimetres (96.99 cubic inches). I have already remarked that this number is far higher than the mean taken from modern Parisians; it is equally so in comparison with other European nations."

These facts all conspire to prove that the cultivation of thousands of years has not increased the size of human skulls. In 1886, we measured many of the skulls unearthed at Pompeii, the remains of Romans who lived nearly two thousand years ago, and we found them on the average larger in every way, but especially in the forehead, than the skulls of Romans of this century.

In the museums of Switzerland we measured in 1887 several skulls of the ancient lake dwellers of that country, and found them larger in all respects, but particularly in the forehead, than those of the Swiss people of the last fifty years. The average circumference of the skulls we measured in the catacombs of Paris was twenty-one inches and a half, which is about an inch more than that of Parisians who have died within the past fifty years.

"The average internal capacity of the Peruvian skull is only seventy-three cubic inches; that of Toltec skulls, seventy-seven inches, and that of barbarous tribes, eighty-two inches; so that the extraordinary anomaly is presented of a larger brain being possessed by the barbarous tribes than by the nations who achieved no mean degree of civilization in Central America and Peru. The average

European skull is ninety-three inches in bulk." * The author was informed by Mr. Lucien Carr, of the Ethnological Museum of Harvard University, that the capacity of the Peruvian skulls was about one hundred centimetres smaller than that of the skulls of any other people living in America at the same time. Yet that small-headed people was the most highly civilized of all.

SPELEOLOGY, OR CAVE EXPLORATION.†

By M. E. A. MARTEL.

THE not very graceful word *speleology* was composed a few years ago by M. Émile Rivière out of Greek elements, as a translation of the German *Höhlenkunde*, to signify the study of caves. The study claims a place among the sciences, and is, I believe, able to justify its claim. Caves have been subjects of interest and curiosity in all times and countries. In the primitive ages, when palæolithic man was obliged to defend himself against the large Quaternary wild beasts, and did not yet know how to construct cabins, he lived in the most inaccessible caves, or those easiest to close, which he could find. Afterward, when man had advanced in civilization to the neolithic stage, and had somewhat improved tools and arms, having learned to build huts and villages, caves became simply burial places. In the historical periods of antiquity they were transformed into pagan sanctuaries or temporary hiding places in times of revolt, civil war, or invasion. Down to the middle ages and the renascence, they shared this function with abandoned quarries. Through these changes they gradually became objects of popular fear and absurd legend. I have nearly everywhere in France found legendary and profound belief in some monstrous basilisk or dragon in the depths of dark caverns, guarding immense treasures; and woe to the rash adventurer who tried to steal these riches!

In short, caves have suffered their vicissitudes; their use as habitations seems to be inversely proportioned to the degree of civilization. The miserable aborigines of Australia have not yet quite abandoned them; and in France the present occupation of the grottoes of Ezy, in the Eure, by some outcast families, who lead a sordid existence in them, indifferent to all social conventions, has recently been cited as an extremely curious anthropological phenomenon.

Science, too, has laid its hold on caves only within a little more than a century; for it was not till 1774 that Esper recognized that

* Eclectic Magazine, December 14, 1863, p. 428.

† From an address before the Société des Amis des Sciences.

the large bones taken from the caverns near Baireuth, in Bavaria, were not those of human giants, but of extinct animals, and he called them, they being petrified by limestone, *zoöliths*, or animal-stones; and it was his remarks upon them that drew Cuvier's attention to paleontology.

Three sciences have of late years been advanced by the explorations of caves: paleontology; prehistory, or research among the remains of primitive men and their industries; and zoölogy, or the study of living beings. The animals of caverns—crustaceans, insects, batrachians, and fishes—constitute a special fauna, which has been for fifty years a subject of study to naturalists of various nations, and to the anatomy of which M. Armand Viré, of the Natural History Museum of Paris, has been giving special attention for five years past.

There are other sciences the study of which in connection with caves, while capable of yielding valuable fruits, has been too long neglected: geology, for their origin and formation; mineralogy, for their relations to metallic veins; meteorology, for thermometrical and barometrical variations and the formation of carbonic acid; terrestrial physics, for the experiments on gravity that might be carried on in deep vertical pits, supplementing the observations of Foucault in the Pantheon at Paris, and Airy in the English mines; hydrology, which has hardly yet perceived that caves are predominantly great laboratories of springs; agriculture, which might transform them into reservoirs for times of drought or storage basins in case of flood; and public hygiene, which is just beginning to discover that they may harbor in their fissures hitherto unsuspected causes of contamination of the water of the springs that issue from them. The number and importance of these new problems that have arisen from the recent extension of underground investigations seem fully to justify the specialization of the science of caves—another creation of the Speleological Society, now four years old. This special interest in the science of caves began about fifteen years ago, when, in 1883, three members of the Austro-German Alpine Club—Herren Harske, Marinitsch, and Müller—resumed in the limestone plateaus of Istria and Carniola called the Karst, explorations which had been actively and profitably carried on in the middle of the century, from 1850 to 1857, by Dr. Adolf Schmidt, whose discoveries in the caves of Adelsberg, Planina, and St. Canzion won him a membership in the Vienna Academy of Sciences. Their efforts and those of Herr F. Kraus, who died last year, had the result of interesting the Austrian Government in the subject; and since 1886 various engineers have been commissioned by the Minister of Agriculture to make official explorations and construct economical works in the caves and underground rivers of Istria, Carniola, and Herzegovina. Credits are granted every year for enterprises which prove to be more useful than would at first be thought.

It was at the same time, between 1883 and 1885, that I made my first investigation in the Causses of Lozère, Aveyron, and the adjoining departments of France, the results of which were to reveal for the first time to the public, and even to geographers, the picturesque beauties, then unknown, and now becoming the fashion, of the gorges of the Tarn, Jenta, and Dourbie, the rocks of Montpelier le Vieux, etc. In my excursions over the plateaus of the Causses I frequently met, at the level of the surface, open, dark holes, and mouths of vertical wells—*avens*—the depths of which no one had ever looked into, unsoundable, they said, which the peasants naturally took to be real mouths of hell. Recollecting what I had admired at Adelsberg and in various caves of the Pyrenees, I guessed these avens might also be doorways to subterranean splendors and scientific treasures. So I began in 1888 the methodical exploration of the unexamined natural cavities of my own land first, and then of other countries of Europe; and since then I have devoted several weeks every year to this work.

These pits are simply horizontal holes opening upon the surface of the ground, of very different forms and dimensions. Herdsmen are very careful not to let their cattle go too near them, for they sometimes fall in.

The diameter of these pits varies from a few inches to several hundred yards, and they are sometimes more than six hundred feet deep. It is not easy to go down into them, especially when they are on high levels away from habitations and roads. In such cases a considerable apparatus of ropes, rope ladders, telephone, portable boat, tent, etc., has to be taken along. The first measurement with the sounding line gives the depth only of the first pit—and there are often several succeeding one another. A rope ladder long enough to reach the bottom is then let down, and the man who descends has a rope tied about him for additional security, which is held by the people above. A great many pits are narrower at the top than lower down, forming something like a reversed speaking trumpet, so that the explorer finds it very difficult to make himself heard at the top; hence I have adopted the practice of taking a telephone along. The interior shapes of the pits are very diverse. The narrower ones are easiest to go down, because they permit one partly to support himself against their walls. The wider ones leave him hanging loose, in a position which he feels to be very precarious. When there is a second or third pit, and we have not ladders enough, we have to trust ourselves to a simple rope with a board fastened at the end of it for a seat. The *gouffre* of Vigne Close, in Ardèche, which is about six hundred feet deep, has five successive pits, and its complete exploration required three days. The bottom of the pit may be a simple cleft in the rock, or an immense cathedral-like chamber; as at Rabanel, near Ganges, and Hérault, the deepest abyss in France, the vault of which expands into a gigantic nave, five hundred feet high, which is lighted by the beam of light that falls through the opening, presenting a grand and indescribable spectacle. Some pits of less depth, as the Tin doul de la Vayssière, in Aveyron, and the Padirac well, in Lot, both leading to underground rivers, enjoy a still more complete illumination. Considerable talus banks close the ends of these broad pits, and are generally produced by the caving in of the roofs of caves.

Lively controversies and gross errors have prevailed concerning the geological formation of abysses. The abyss of Jean Nouveau, Vaucluse, among others, furnishes evidence against the false hypothesis that such pits are as a rule the results of cave-ins, whereas pits of that origin are rare and exceptional. These pits are for the most part fissures, the principal feature of which is their narrowness. At Jean Nouveau the greatest breadth is not more than about sixteen feet. It is the deepest vertical pit of a single shaft without intermediate terraces that we know of, and is about five hundred and thirty feet from the surface of the ground to its floor. The mass of stone rubbish at the bottom prevented our descending into a second pit.

Pits composed, like Vigne Close, of several successive wells, destroy another hypothesis—that of the formation of *gouffres* by the emissions from thermal springs.

The greatest danger in descending these pits arises from the showers of stones that sometimes come down upon the head of the explorer. These are often started by his friends the hunters, or by their dogs gamboling around at will.

While some of the caverns I have explored were stopped up by obstacles of one kind or another that prevented further progress, in others we found considerable rivers running a nearly free course. We rarely found pits formed by the collapse of the roofs of the cave in cases where the distance from the subterranean river which by its work of erosion provoked the catastrophe to the surface was more than one hundred metres. The pit of the Mas Raynal, Aveyron, is one hundred and six metres deep, and abuts upon a large subterranean river, which supplies the Sorgues of Saint-Affrique, one of the finest springs of France. When we explored it, in 1889, we could not pass the low chambers which occur in it because the water was too high, and we have not visited it since. Its exploration in a dry season might reveal many very interesting chambers.

In the cave of Rabanel, the first well, which ends in a talus of fallen stones, furnishes an instance of a vertical fissure grafted, if we may use the word, upon an interior grotto that already existed. A stream runs through this grotto which falls into a second well twenty-six metres, and is then lost in smaller passages so nearly stopped up with earth that we were not able to follow it through its course of about a mile till it comes out at the Brissac spring.

The cave of Trebiciano, in Istria, near Trieste, the deepest known, has a total depth of more than a thousand feet. It is not, however, entirely natural, but is composed of numerous vertical fissures which lead, at about eight hundred and fifty feet below the surface, to a large cavern, at the bottom of which flows the subterranean river Recca. The fissures do not naturally communicate directly with one another, but the engineer Lindner was commissioned in 1840–'41 by the city of Trieste to construct for the municipality a supply of potable water from the underground streams, and after eleven months of labor made artificial connections between the different parts of the chasm.

These vertical pits are formed by the wearing down, from the top, by the waters which become ingulfed in them. This mode of their formation was demonstrated to me in 1895, when I was in Great Britain under a commission from the French Minister of Instruction. I then explored several caves in which the rivers were still running, and satisfied myself that the pits were simply absorbing wells. Such wells are not effective now in southern France and Austria, but in northern Europe, where rain is more abundant, they are still operative. I found the plainest evidence of this fact in Yorkshire, at the Gaping Ghyll, Ingleborough, where a river precipitates itself at one leap one hundred metres under the earth. English investigators and travelers had tried without success to descend into it in 1845, 1870, and 1894, having conquered only about one hundred and ninety-five feet of its total depth of two hundred and twenty-nine feet. It took me twenty-five minutes to go down upon a rope ladder which was suspended in the midst of the cascade. Fortunately, the pit had the daylight to the very bottom—a wonderful spectacle, compensating me for all my trouble and the long douche bath which greeted me at the end of the descent, where stretched an immense Roman nave nearly five hundred feet long, eighty feet wide, and ninety feet high, without any sustaining pillar. From the middle of the roof of this colossal cavern fell the cascade in a great nimbus of vapor and light—a wonderful fantastic scene, such as Gustave Doré or Jules Verne could never have imagined.

The most pleasant feature of the whole of it, however, to me was the thought that I had succeeded where the English had failed, and on their own ground. The people were nevertheless very pleasant to me, and at my instance have continued the exploration and made some new discoveries.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

SKETCH OF CHARLES HENRY HITCHCOCK.

THE name of Prof. Charles H. Hitchcock is closely associated with the progress of New England geology, especially with the discovery of the great terminal glacial moraine, and, in connection with the name of his father, Dr. Edward Hitchcock, with the study of the fossil bird tracks of the Connecticut River Valley.

Charles Henry Hitchcock was born in Amherst, Massachusetts, August 23, 1836, the son of Prof. Edward Hitchcock, the eminent geologist, who was afterward president of Amherst College. The family is of English origin, and was planted in America by two brothers who came over at nearly the same time and made homes for themselves in New Haven, removing later to towns near by. Luke Hitchcock, the ancestor of the subject of this sketch, came in 1695, and finally settled at Wethersfield, Connecticut. His descendants in the direct line lived at Springfield, Granville, Deerfield, and Amherst, Massachusetts. Professor Hitchcock is in the seventh generation from Luke, and is equally removed from Elder John White, his maternal ancestor, who came to Canton, Massachusetts, toward the end of the seventeenth century, and removed thence to the Connecticut Valley. Both lines of ancestry were purely English, and all the progenitors were men of integrity, regarded in their times as worthy to fill offices of trust in church and town. Two of them served in the Revolutionary army.

The father of Professor Hitchcock was one of the most distinguished geologists and educators of his time, and his services, especially as State Geologist of Massachusetts, have already been described in the Popular Science Monthly.* His mother was the daughter of Jacob White, a well-to-do farmer of Amherst, who, believing in the education of women, had given her the best opportunities for study available at the time. She could read the Greek Testament and calculate eclipses, and was a gifted artist with pencil and brush. She prepared with her own hands many of the numerous illustrations in her husband's reports, and also diagrams for the

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lecture room. She took indefatigable pains with the education of her children, placing their moral and religious welfare first. Of the eight children of the family, six of whom reached maturity, the surviving brother is professor of physical culture, and, for the time being, acting president at Amherst College, and one of the two surviving sisters, the widow of the Rev. C. M. Terry, has been for several years matron of the Hubbard Cottage, Smith College, Northampton, Massachusetts.

Beginning with 1835, the year before Professor Hitchcock was born, his father, Professor Edward Hitchcock, was largely occupied with the study of the "fossil bird tracks" in the New Red Sandstone of the Connecticut Valley, and with the discussions to which the investigation gave rise, the story of which has been told by Prof. C. H. Hitchcock himself in the Popular Science Monthly (vol. iii, August, 1873). Besides the search for the fossils and their collection and comparison, and the examination of the literature that might throw light on the subject, there were studies into the proper interpretation of the early chapters of Genesis, the debate with Prof. Moses Stewart, of Andover, and the gradual approach of the American clergy to general acquiescence in the belief that geology is not at variance with Scripture. Professor Hitchcock's childhood was largely spent under the influence of these studies and discussions. The boy seemed to be full of promise, and because of his observing ways and proneness to speculation was called "the young philosopher." He used to bring his mother the very small flowers of *Spergula rubra*, which are so obscure that older eyes often fail to notice them. He seemed to be fonder of his father than the other children, and was never so happy as with him. Through this constant intercourse Charles became absorbed in his father's pursuits, and grew up into a knowledge of geology from Nature and from verbal explanations—a more satisfactory method than that of learning from books; and he was associated with his father in all his geological work from the time when he was first old enough to be of service. Thus, before 1856 he was acquainted, from inspection, with the terraces and reputed beaches and drift phenomena of all western Massachusetts; he had handled every specimen of a foot mark in the Appleton Cabinet, and by 1861 was the principal assistant on the Vermont Survey, having prepared for the press the greater part of the matter of the report. He had enjoyed the best educational advantages of his day, having completed the classical and preparatory courses of Williston Seminary, and been graduated thence in 1852, then graduated from Amherst College in 1856, a short time before his twentieth birthday. Among his early classmates and college friends were Dr. Cyrus Northrup, president of

Minnesota University; Dr. Richard Mather, professor of Greek at Amherst College; the Rev. Dr. Goodwin, of Chicago; and Dr. William Hayes Ward, editor of The Independent. After graduation he spent a year in special study of Hebrew and chemistry at Yale College, two years at Andover Theological Seminary, and one year in Europe, studying in the Royal School of Mines under Professor Huxley, and in the British Museum investigating the crustacea and trilobites. Here he enjoyed the friendship of Professor Richard Owen, and had the guidance of Dr. H. Woodward.

In 1857 Mr. Hitchcock was appointed assistant geologist to the Geological Survey of Vermont. He served the full term of the survey, and had charge of the preparation of the report relating to the stratigraphical geology, the measurement and delineation of the sections, and the compilation of the geological map.

In 1861 he received the appointment of State Geologist of Maine, in which service he spent two summers in field work, preparing two reports of progress, which were published in connection with the report of the secretary of the Board of Agriculture. Besides the general reconnoissance, he discovered the existence of large areas of Upper Silurian and Devonian terranes. He has embodied his views of the distribution of the formations in his general map of the United States.

Having chosen the ministry for his profession, Mr. Hitchcock studied theology under Dr. E. A. Park, of Andover, and the Rev. Dr. Taylor, of New Haven. Questions of the relations of theology and science were attracting much attention, and he treated of them in two papers in the *Bibliotheca Sacra*, one of which was afterward used for the guidance of theological students in several seminaries. As more opportunities were offered for scientific work, the ministry was given up. This was the time when the doctrine of natural selection came to the front for investigation, and the early history of mankind was receiving increased attention. Mr. Hitchcock came home from Europe in 1867 convinced of the truth of some form of evolution, of a considerable antiquity of man, and of the probability of a plural origin of the human race. Finding that some of his views on these subjects were not acceptable to his associates, he ceased to make them prominent in his class instructions, and devoted his attention to the more technical details of geology. Since then general opinion has advanced so far on these subjects that the views he held at that time seem now really conservative.

In 1868 he was appointed State Geologist for New Hampshire, and spent ten years in the survey of that State. The results of his work there were published in three large quarto volumes, with a folio atlas of maps, profiles, and sections. The rocks described consist principally of crystalline schists and marine igneous ejections. The geology of New Hampshire is of peculiar importance, because the situation of the State is such that a correct knowledge of its rocks promotes the understanding of many obscure terranes in the adjacent regions of Maine, Quebec, Vermont, and Massachusetts. Professor Hitchcock's report of the survey may justly be styled his chief work. The part best studied relates to the White Mountains and the Ammonoosuc mining district. Connected with the survey was the maintenance of a meteorological station throughout the year on the summit of Mount Washington. Daily statements of the weather conditions of this station during the winter of 1870–'71 were sent by telegraph to the principal newspapers, and called out much interest—before the United States Signal Service began its weather predictions.

The catalogue of Professor Hitchcock's publications comprises more than one hundred and fifty titles of papers, reports, and books. Perhaps the earliest thorough study represented among them was that of the fossil footmarks. The first of the published papers on this subject related to the tracks of animals in alluvial clay, and was published in the American Journal of Science in 1855. For several years after this he assisted his father in arranging the museum and compiling tables for the Ichnology. He made a complete catalogue descriptive of the more than twenty thousand individual impressions preserved in the Appleton Cabinet, which was printed, with descriptions of a few new species of footmarks, in the Supplement to the Ichnology of Massachusetts, edited by him after the death of his father in 1865. Although circumstances have prevented him from paying much attention to ichnology in later years, he has prepared several papers on the subject, the most important of which was one on the Recent Progress of Ichnology, which was read before the Boston Society of Natural History about twelve years ago. In it the ichnites were carefully catalogued anew and classified in the light of our knowledge of the numerous dinosaurs of the West; and the results of some studies of the slabs exhumed at Wethersfield, Connecticut, are well known. The list of the Connecticut footmarks was increased from one hundred and nineteen in the Ichnology to one hundred and seventy; and facts were cited to show that the *Grallator*, the three-toed animal most allied to birds, possessed a caudal appendage of a reptilian nature. The Trias of New Jersey had been found to illustrate new features in the *Otozoum*, whose tracks are often ornithic in aspect. A comparison of the features of the Triassic skeletons described by Marsh from Connecticut (*Anchisaurus*) shows that the creatures were rather allied to the *Plesiornis* than to the *Anomœpus* of the Ichnology, because of the great size of the fore feet. Notes upon footmarks have been gathered also from illustrations in Pennsylvania, Nova Scotia, Kansas, Nevada, and Florida.

Professor Hitchcock has studied the Quaternary or glacial deposits with great success. His first publication upon the terraces and allied phenomena of Vermont appeared while the old views of a submergence, with icebergs, prevailed, to account for the phenomena. A study of the glaciers of Switzerland in 1866 satisfied him of the truth of Agassiz's theory; and whenever the opportunity came for re-examination of the surface geology of northern New England, the facts were found to require a different theoretical explanation. He caused a thorough examination to be made of the Connecticut River terranes by Warren Upham in the New Hampshire Survey, and proved that all the high mountains of Vermont, New Hampshire, and Maine had been glaciated by a southeasterly movement. The ice came from the Laurentian highlands, pushed in a southern direction down the Champlain-Hudson Valley, with a southeasterly flow over New England and southwesterly over the Adirondacks; the last two courses having been subordinate to the first. At present the Laurentian hills are lower than the New England and New York mountains overridden by the ice, and probably the same was the case in the Glacial period. The best explanation of these paths is afforded by the suggestion that a gigantic ice cap accumulated north of the St. Lawrence, towering into the clouds so much that its overflow naturally descended over the White and Adirondack Mountains.

That glaciers should accumulate terminal moraines is axiomatic, but no geologist before 1868 had ventured to suggest where moraines might be located in the United States. In that year Professor Hitchcock delivered a lecture before the Lyceum of Natural History in New York and the Long Island Historical Society in Brooklyn, in which he affirmed that the drift deposits from Prospect Park along the backbone of Long Island for its entire length constituted the terminal moraine of the great continental ice sheet. This declaration inaugurated a new era in the study of the age of ice. The geologists in their several States found the terminal moraines, and the various phenomena began to be classified according to new laws. The search for moraines has resulted in a restatement of the incident of the age of ice; more than a dozen successive terminal moraines have been mapped between New York and Montana, which suggest to us the existence of several glacial periods. In compiling a catalogue of observations of the course of glacial striæ by the United States Geological Survey, it was found that Professor Hitchcock had recorded for New England as many as all other geologists had observed for the whole country.

Eskers are another interesting class of phenomena, and were first described as *horsebacks* in Maine, about seventy of them having been described in the report of 1861 and 1862. It was not till after the description of the Swedish Åsar that the nature of these lines or ridges was understood; and now they were found in every prominent valley in New England, as attendant upon the recession of the ice sheet. Professor Hitchcock gave the correct name of these ridges in his Elementary Geology, 1860; while for many years subsequently they were erroneously called *kames*, even in the geology of New Hampshire.

Professor Hitchcock gave the name of Champlain to the fossiliferous clays associated with the till of the Atlantic coast. The term has come into general use as connected with the melting of the ice in the latter part of the period. Because of the presence of boreal species, and of analogies with similar deposits in Europe, Professor Hitchcock has asked the question whether there may not have been a Champlain glacial epoch posterior to those named farther in the interior of the country, the Kansan, Iowan, and Illinoisian epochs.

Those who explore the geology of northern New England have to deal with crystalline rocks of various ages, and the opinions of our best geologists have not been in agreement respecting them. Professor Hitchcock was the first to make a geological map of New Hampshire, and he also demonstrated the anticlinal nature of the Green Mountains of Vermont. His teachers had inculcated the view that these eminences belonged to a synclinal disposition, coupling this with theoretical assertions as to their age and metamorphism. Finding their main principle to be erroneous, he naturally disparaged their theories, though more recent studies are eliminating many of the schists from the Archæan. All the later explorers in the field—Canadians and members of the Geological Survey—accept a pre-Cambrian anticlinal in the heart of the Green Mountains.

The distribution of the New Hampshire formations was made out for the most part before any assistance was derived from the labors of Dr. G. W. Hawes and other petrographers. Twenty years ago, at the date of the final publication of the New Hampshire maps, the doctrine of an igneous origin of the crystalline schist had hardly been hinted at. What seems elemental to the modern petrographer who has acquired his technical education since 1890 was unknown then, and the classification given in the report may not agree with that now taught. In the midst of the diverse views entertained, Professor Hitchcock classified the rocks of northern New England according to this principle: rocks that are identical in petrographical composition are assumed to have had the same origin, and to be synchronous. Professor Hitchcock was almost the first of American geologists to employ the petrographer as a help to the understanding of the crystallines—as was evident by the very valuable contributions to knowledge in Part IV of the New Hampshire Report as prepared by Dr. Hawes.

A vexing question concerning what are now called Cambrian terranes divided geologists for a quarter of a century after 1857, and had to be considered in preparing the geology of Vermont in 1861. This was the Taconic controversy. Trilobites had been discovered in Vermont, which were misunderstood by most of the American geologists following Hall, Logan, Dana, and others. In giving the species the technical name first of *Barrandesi* and then *Olenellus*, Prof. James Hall asserted its derivation from the Hudson River group—relying upon the stratigraphical determinations of Sir W. E. Logan. As soon as Barrandes's attention was called to these trilobites and the attendant publication, he wrote his famous letter to Logan in 1860, declaring that there must be a mistake somewhere. That error was discovered in time to be eliminated from the Vermont report of the following year. Professor Hitchcock had charge of the field work in this Cambrian district, and his views of the arrangement of the formations are in agreement with those of the latest workers in the field. He applied the term of *Georgia* to one division of the terrane in 1860; and the designation has been generally adopted since that time. Jules Marcou claimed priority in the suggestion of the application of the term, but upon the publication of Professor Hitchcock's statement on the subject the credit of priority was awarded to him by Director Walcott, of the United States Geological Survey.

Between 1860 and 1870 Professor Hitchcock was occupied largely as a mining geologist in the estimation of mineral deposits for mining companies, with his office in New York. In the prosecution of this business he traveled in Nova Scotia, New Brunswick, Quebec, Maine, New Hampshire, Vermont, New York, New Jersey, Pennsylvania, Maryland, Virginia, Ohio, Kentucky, and Alabama. Subsequently, the study of the phosphate beds led him to the island of Redonda in the West Indies. He further visited the phosphate beds of South Carolina and Florida, the gold fields of eastern Oregon, the Chalcedony Park of Arizona, the Grand Cañon of the Colorado, and the Yosemite and Yellowstone Parks. Studies made in the Hawaiian Islands and their volcanoes in 1883 and 1886 resulted in the contribution of important observations respecting those regions. At the present writing Professor Hitchcock is spending a year of further observations in those islands.

Mr. Hitchcock was appointed, in 1858, lecturer in zoölogy and curator of the cabinet in Amherst College; an office which he filled for seven years, retiring after the death of his father. In 1866 he was elected professor of geology in Lafayette College, where he gave short courses of instruction to five successive classes. In 1868 he was called to the chair of geology in Dartmouth College, a position which he still occupies, receiving a year's leave of absence for 1898–'99 in consideration of thirty years of service. He taught geology and zoölogy as a provisional professor at Williams College in 1881, and in the following year in the Virginia College of Agriculture and the Mechanic Arts, Blacksbury. He received the degree of M. A. in course at Amherst in 1859, the honorary degree of Ph. D. from Lafayette College in 1870, and that of LL. D. from Amherst College in 1896.

Professor Hitchcock has been connected with the American Association for the Advancement of Science since 1856, and a nearly constant attendant upon its meetings and participant in the proceedings. He is a member of local scientific societies in Portland, Me., Boston, Mass., New York, Philadelphia, and St. Louis, and also of the Imperial Geological Institute of Vienna. He was one of the most prominent movers in the inception and early history of the Geological Society of America, and had much to do with the organization of the International Congress of Geologists, and with the preparation of special reports for the several meetings between 1876 and 1890. The handsome geological map of small scale compiled for the United States was prepared by him and published in the Transactions of the American Institute of Mining Engineers (1887), to illustrate the nomenclature and color scheme of the International Congress.

Professor Hitchcock is best known to many by his geological maps. The first efforts at mapping the geology of the United States were made independently by Edward Hitchcock and Jules Marcou in 1883—the work of Mr. Marcou extending only to the plains. Prof. H. D. Rogers, five or six years later, prepared a map for Johnston's Physical Atlas. In 1872 Prof. C. H. Hitchcock and Prof. W. P. Blake compiled a map for the ninth census of the United States, and for R. W. Raymond's report upon the mineral resources of the country. The success of his small scale map led Professor Hitchcock to undertake the preparation of a map on a scale of twenty-five miles to the inch for the whole country. For this he consulted every work that had been printed upon the geology of the United States, and obtained the privilege of using many unpublished data collected by geologists of States and Territories in which the work had never been carried to actual completion. The map prepared by the General Land Office was used as the basis for the geological coloration, and the work appeared in 1881, of a size adapted to use in the classroom. Its compiler has never seen any criticism of its accuracy. The edition prepared for the Mining Institute embodies all the information acquired for the large map, with such additional facts as had been learned since that map was published. Prof. Hitchcock's services were called into requisition in the compilation of a similar map for the United States Geological Survey, which was published in its annual report for 1886, under the editorship of W J McGee; in fact, the two maps were printed from the same plates, but Dr. Hitchcock's contained certain features not found in the other one—the result of different interpretations—and was more complete. In the Government edition a system of coloration devised by Major J. W. Powell, which was afterward abandoned, was employed.

Professor Hitchcock contributed extensively to the collection of State geological maps in the Centennial Exhibition of 1876, when large scale sheets of New England, and a large copy of the Hitchcock and Blake map of 1872, were exhibited. A medal was awarded for a sheet of thirteen sections illustrating the stratigraphy of Vermont and New Hampshire. The beginning of the measurement of sections was made for the Vermont Geological Report under the direction of Dr. Edward Hitchcock in 1861. Twelve lines of exploration across the entire State were determined upon, and specimens were collected to illustrate all the varieties of rock seen upon each. The specimens were arranged in the State Museum at Montpelier in geographical order. A similar plan of collection and arrangement was projected for the New Hampshire survey, but it was made to extend across the two States, from Maine to New York. Besides the two State reports, later publications were issued, descriptive of explorations and collections for the Bulletin of the American Museum of Natural History in New York, and the New Hampshire Agricultural Report for 1883. The work did not cease with these publications, for after the transfer of the collection of sections from the New Hampshire College of Agriculture and the Mechanic Arts to Dartmouth College in 1894, additional explorations were made; the number of sections was increased to eighteen; improved drawings of the profiles, colored geologically, were prepared for the cases in the new Butterfield Museum; and the explanation of the details was further facilitated by the construction of a large relief map on the scale of one mile to the inch horizontally, twice as much vertically, and having colors corresponding to those on the profiles between the shelves. About five thousand specimens have been gathered to illustrate the profiles.

The Dartmouth College Museum is filled with specimens accumulated by the energy of Professor Hitchcock. They concern geology, paleontology, petrography, economic botany, and conchology.

Editor's Table.

EVOLUTION AND EDUCATION.

OUR attention has been drawn to a lively discussion that has lately taken place in the St. Paul papers over the utterances, on the subject of the doctrine of evolution in its relation to education, of a certain Mr. Smith, who was appointed not long since superintendent of the public schools of that city. What seems clear is that Mr. Smith is a very ignorant man, whose views in regard to education are of an altogether retrograde character. How he came to be appointed to his present position is a question which is being gravely pondered by many of the citizens; but probably the explanation is not very far to seek. The dispensers of patronage in State and municipal affairs are not always competent to make the best nominations to offices calling for high qualifications; and sometimes they do not even act up to their own indifferent lights. The man that has the pull is very apt to be the man that gets the office, and it is not often that the strongest pull goes with the highest professional fitness.

However this may be, there Mr. Smith is, and what kind of a man he is may be judged from his utterances. It is thus that he refers to Mr. Spencer: "There is an old man in England who for years has spent all his time and devoted all his energies to the attempt to create a system which shall entirely ignore the name of the Deity. He will shortly die, and it shall not be remembered that he ever performed an act or said a word that blessed or comforted or relieved his suffering fellows." To further darken the picture, he contrasts Spencer with the late Cardinal Newman, who wrote the hymn "Lead, kindly light," and who, we are told, if he had done nothing more, would have been "followed by the blessings and the prayers of those whom he had comforted and saved." Again, dealing with the modern scientific view that, in the development of the human individual all antecedent stages of human development are, in a manner, passed through, he says: "Let us discard the primitive-man theory. You do not believe it. Rather shall we not hold with Emerson that every child born into the world is a new Messiah given into the arms of fallen humanity to lead them back to paradise?"

It is no part of our purpose to defend Mr. Spencer against the attacks of so negligible an assailant as Mr. Smith, of Minnesota. The words that Mr. Spencer has spoken for truth, for justice, for humanity, for peace, are his sufficient commendation and vindication—were vindication needed—in the eyes of all who have any competent knowledge of contemporary thought. If these words do not help to make the world better we should feel little inclined to put our trust in the most skillfully constructed sacred lyric. Men do not always know their benefactors; and it is altogether possible, nay probable, that thousands who perhaps never heard Mr. Spencer's name have benefited through the greater consideration with which they have been treated by others, owing to his teaching. It is quite possible for men, yes, and women too, to sing "Lead, kindly light" with great unction, and yet to be the ardent abettors of warlike sentiments and warlike acts—to revel in a ruthless and immoral jingoism.

Dryden was not referring to the adherents of any evolutionist philosophy when he wrote:

"In lusts we wallow, and with pride we swell,
And injuries with injuries repel;
Prompt to revenge, not daring to forgive,
Our lives unteach the doctrine we believe."

"Not daring to forgive" is good, and nearly as true in the nineteenth century as it was in the seventeenth. The one English statesman who dared to forgive a defeat inflicted on English arms and to acknowledge an error, incurred by that single act a deeper hatred and contempt than he earned by anything else, or all else, in his long and storm-tossed career. We refer to the action taken by Gladstone after the battle of Majuba Hill. And we are much mistaken if the majority of those who execrated him most deeply for not crushing the Boers under England's overwhelming force were not immense admirers of the cardinal's hymn. What is certain is that they were not immense admirers of Spencer, and that Spencer did not immensely admire them.

Superintendent Smith has quoted Emerson, but he does not occupy the standpoint that enables him to see Emerson in true perspective, or to feel what his philosophy lacks when confronted with the newer knowledge of the century. Mr. J. J. Chapman, in his recent memorable book of essays, gives us a better view. "A critic in the modern sense," Mr. Chapman says, "he (Emerson) was not. He lived too early and at too great a distance from the forum of European thought to absorb the ideas of evolution, and give place to them in his philosophy. . . . We miss in Emerson the underlying conception of growth, of development, so characteristic of the thought of our own day, and which, for instance, is found everywhere latent in Browning's poetry. . . . He is probably the last great writer to look at life from a stationary standpoint."

That the doctrine of evolution constitutes to-day a most important guiding principle in education no competent educationist could be found to deny. It teaches us to deal with the young as in a very true sense the heirs of all the ages, to make due allowance in childhood for instincts and habits which partake of the earlier stages of human development, and to look forward with confidence to later and higher manifestations. We have less faith than our ancestors had in the rod, and more in the gradual unfolding of the powers and capacities of the mind, and therewith the enlargement and improvement of the moral nature. We do not believe as our forefathers did in breaking children's wills; nor do we view their peccadilloes in the lurid light of a gloomy theological creed. We recognize that veracity, in the sense of strict accuracy of speech, purged of all imaginative elements, is a virtue which not all adults are able to practice, and which is not a natural product of the child mind. We can not accept Emerson's doctrine of infant Messiahs, and yet we can recognize very fully the mission of the child in the home, the demand it makes for tenderness, for patience, for thoughtfulness on the part of parents, the hopes and fears and heart-searchings that it calls into play, the aspirations that it promotes toward the realization, if for its sake only, of a higher life. Froebel grasped a large measure of truth in regard to children, but too much of sentiment, in our opinion, entered into his treatment of them. In the full light of the doctrine of evolution we take them as they are, and help them to work out under favorable conditions that development of which they are capable. We are not imposed upon by childish imitations of mature virtues, and are rather disposed to repress recognized tendencies to precocity; but we believe that the germs of good are sown in every normal human being, and that, unless killed by most unwise treatment, they will fructify in due time.

What we may well consider seriously is whether our modern modes of life enable us to do that justice to children which evolutionary teaching requires. Can true health of body and mind be conciliated with social ambition or with commercial ambition? Are we not hampered at every turn by false schemes of education, the object of which is to turn out certain conventional products? How many of us can rise up in effective rebellion against the very fashions that in our hearts we most condemn? Before there can be anything like a perfect education for the young there must be a much more fully developed sense of duty than we see as yet in the older generation. The doctrine of evolution is putting the key to a true system into our hands; but to use that key aright requires courage and high purpose—qualities that are not of everyday occurrence. Still, it is matter of congratulation that the truth is not far from us. It is well established in our theories, and one of these days we may hope it will gain a wide and secure footing in our practice.

DAVID AMES WELLS.

In the death of David A. Wells, which occurred at his home in Norwich, Connecticut, on the 5th of November, 1898, America has lost one of her ablest and most productive men of letters and science a distinguished representative. Out of a life of seventy years it may fairly be said that Mr. Wells gave fifty of them to intellectual pursuits, which were mainly devoted to the advance of science and its application to practical affairs. After passing the period of early study, and particularly since he became interested in economic questions, much of his work was in the line of original investigation, the results of which have from time to time been given to the public either through his books or in the magazines. Another and more conspicuous feature of his career, the one perhaps that made him best known at home and first gave him reputation abroad, was the valuable service that he rendered the country at large in straightening out the financial tangle the Government had got itself into during and after the civil war. In this undertaking his great store of learning, rare practical sagacity, and unwavering confidence in the final result, carried him through to a brilliant success, earning for him in high quarters the most flattering testimonials of admiration and respect.

Looked at in the light of what he actually achieved, Mr. Wells's preparation for his life work seems to have been almost an ideal one. Gifted with a strong love of Nature and having a decidedly practical turn of mind, he early showed a fondness for the study of science. This led him, soon after graduating from Williams College in 1847, to enter the Lawrence Scientific School of Harvard University. Here he completed the course with the first class that was graduated by that institution in 1852. While studying in the scientific school young Wells became the special pupil of Agassiz, and, as the sequel shows, caught the enthusiasm with which that great master was wont to inspire the young men who were fortunate enough to come within the range of his influence. During this period Mr. Wells, in association with Mr. George Bliss, began the compilation and publication of the Annual of Scientific Discovery, which he continued for some sixteen years. That he was a clever student with quite exceptional endowments is seen in the circumstance that immediately after graduation he was appointed assistant professor in the scientific school and lecturer on physics and chemistry in Groton Academy, Massachusetts. He also, between 1857 and 1863, prepared a series of scientific school books embracing the subjects of physics, chemistry, and geology, and a volume on the Science of Common Things, all of which attained a wide circulation.

Thus for a period of nearly fifteen years Mr. Wells had devoted himself assiduously to the cultivation of the physical sciences. Beginning with the practical operations of the laboratory, where the value of experiment and observation is made apparent, his work was continued in the strengthening and developing experiences of the teacher, and thence led up to that wider knowledge and that clearness of exposition which a bright mind would acquire in the preparation of a number of successful scientific class books. It may be presumed that by this time he was thoroughly acquainted with scientific method in its applications to the investigation and explanation of physical phenomena. With the results this had yielded in building up the great body of verified knowledge composing the several sciences he must also have been familiar. Mentally alert and with sharpened powers of observation, he was able to seize and classify the facts bearing upon the problem in hand, and subject them to systematic processes of scientific reasoning.

Such, in brief, was the training and such the equipment brought by Mr. Wells to the study of economic questions when he first began to write upon them in 1864. A better preparation for the work to which he was to give the next thirty years of his life can scarcely be imagined. While it is quite true that in entering this new field he was to encounter a class of facts and variety of phenomena that were of a very different order from those with which he had previously been dealing, their apparently haphazard character did not deceive him. Well versed in the practice of tracing effects to causes, gifted with remarkable powers of insight, and thoroughly believing that the methods of science would prove as available in the study of economics as in other fields, he began his investigations without misgiving, patiently accumulated and studied the facts, and when conclusions were arrived at, no matter how contrary they might be to current teaching, fearlessly announced and defended them. Though half his life a firm believer in the doctrine of protection, when Mr. Wells went to Europe for the Government in 1867 to investigate the subject of tariff taxation, high and low tariff countries alike were visited, with the determination to leave nothing undone that would aid to a better understanding of the question. All the varied aspects of the problem were carefully studied in connection with the principal industries of the respective countries, and, finding reason in the facts thus obtained to revise his opinions, he came home a convert to free trade. For an account of what he had observed during the course of his investigations, and of the conclusions based thereon, the reader is referred to the fourth volume of his reports as commissioner of internal revenue, published in 1869. His book on Recent Economic Changes, and the papers on The Principles of Taxation, that have appeared in this magazine during the last two years, are records of equally painstaking research. Moreover, they are both excellent examples of what a strict adherence to scientific method has done and may yet be expected to do toward clearing up the knotty problems in economics that are now engaging public attention.

United with his great learning, and a rare power of generalization, Mr. Wells possessed in full measure that intellectual honesty which is the indispensable characteristic of the true man of science. This enabled him to follow without doubt or hesitation wherever the facts might lead; and with his clear perception of their real import, joined to his habit of independent thought, traits that are displayed throughout all his more formal writings, they are what in our opinion constitute his title to distinction. They give to his teachings, which have already done more than any other agency that we know toward placing the subject of political economy on a sound scientific basis, a high and enduring character.

A BORROWED FOUNDATION.

"THE central idea of Professor Giddings's Principles of Sociology, a work that has the honor of being the first independent attempt in English to treat of sociology as such, is that we must postulate on the part of human beings what he calls a *consciousness of kind*. Critics of his volume have naturally told him that this is essentially a philosophical idea, found in Hegel and in British ethical writers of the eighteenth century."

We quote the above from an article by Professor Caldwell, entitled Philosophy and the Newer Sociology, in the October Contemporary. We are not prepared to dispute Professor Caldwell's statement that the idea of the "consciousness of kind" may be found in the writers to whom he refers; but it would have been very much to the point if he had mentioned that it is to be found most clearly enunciated in Mr. Herbert Spencer's Principles of Sociology. In an article contributed to this magazine in December, 1896, Mr. Spencer took occasion to point out that what Professor Giddings seemed to regard as an *aperçu* peculiar to himself had been distinctly formulated years before in his own writings. In proof of this he quoted the following passages:

"Sociality having thus commenced, and survival of the fittest tending ever to maintain and increase it, it will be further strengthened by the inherited effects of habit. *The perception of kindred beings, perpetually seen, heard, and smelt, will come to form a predominant part of consciousness*—so predominant that absence of it will inevitably cause discomfort." "Among creatures led step by step into gregariousness, there will little by little be established a pleasure in being together—a pleasure in the consciousness of one another's presence—a pleasure simpler than, and quite distinct from, those higher ones which it makes possible."

The fact is that there is much more in Spencer than most recent writers have ever explored; and the newer sociologists would do well, before putting forward claims to originality, to make sure that they have not been anticipated by the veteran philosopher.

Scientific Literature.

SPECIAL BOOKS.

In *The Play of Animals* * we are offered a book upon an essentially new topic; for, although much has been written concerning the habits and intelligence of animals, no special consideration has been given to their play or its psychic significance. The survey of this virgin territory seems to the critical reader to have disclosed such limitless area to Professor Groos that he fails to indicate its legitimate boundaries. He confesses himself overcome by a sense of its vastness, stating that the "versatility needed for a thorough investigation is so comprehensive that it is unattainable by an ordinary mortal."

Play, he finds, is not "an aimless activity carried on for its own sake"; neither is it the product of surplus physical energy, as Mr. Spencer defines it, for in youth there is playfulness without this condition. Instincts useful in preserving the species appear before they are seriously needed, and are utilized in play, which serves as preparation for the tasks of life. "Animals do not play because they are young, but have a period of youth in order to play."

The special ends accomplished by play are control of the body, command of the means of locomotion, agility in pursuit of prey and in escaping danger, and prowess in fighting. The games pursued in attaining these ends are classified in nine groups, beginning with those of experimentation and ending with those referred to curiosity. They include plays of movement, hunting, fighting, love, construction, nursing, and imitation. For all of these Professor Groos finds but one instinct of play responsible, supplemented by the instinct of imitation. He enters into an elaborate discussion of instinct, giving an outline of Weismann's theory of heredity and the views of various writers. He adopts Herbert Spencer's definition of instinct as a complex reflex act, referring its origin to the operation of natural selection, acknowledging the process to be beyond our grasp. In seeking to explain bird song and the love play of animals, the theory of sexual selection is not accepted by him without qualification; a modification of the Darwinian principle is suggested in which the female exerts an unconscious choice. The psychic characteristics of play are the pleasure following satisfaction of instinct, energetic action and joy in the acquirement of power. The animal at first masters its own bodily movements, then seeks the conquest of other animals and inanimate objects. When a certain facility in play has been gained a higher intellectual stage is entered upon, that of make-believe, or playing a part. This state of conscious self-illusion is reached by many of the higher animals. Psychically, it indicates a divided consciousness, and occupies a place between the ordinary state and the abnormal ones of hypnosis and hysteria. To this condition Professor Groos ascribes the genesis of artistic production, an hypothesis that he has elaborated more fully in *Einleitung in die Aesthetik*.

The experimental plays of animals, divided into those of courtship, imitation, and construction, correspond to the principles of self exhibition,

* The Play of Animals. By Karl Groos. Translated by Elizabeth L. Baldwin. New York: D. Appleton and Company. Pp. 341. Price, $1.75.

imitation, and decoration, which are claimed to be the motives of human art. The acquirement of power through play develops a feeling of freedom, and this the artist likewise seeks to realize in the world of ideals.

Artists will not probably acknowledge that "life is earnest, art is playful," nor moralists agree that "man is only human when he plays, for there is no real freedom in the sphere of experience," yet both may find food for thought in Professor Groos's analysis of play.

In the spasm of unreasoning hostility to Spain which has come over the people of the United States, succeeding a period of effusive admiration, the public are apt to forget that that nation has done anything creditable for the promotion of civilization. Yet, leaving out other fields of culture for the present, it has produced two painters who rank among the great masters, besides numerous secondary artists, rivals of any of that grade in the world, and a voluminous literature which George Ticknor thought it worth while to make the study of his life, and which inspired the pens of Irving, Longfellow and Lockhart. One of the works of this literature ranks among the world's greatest classics, and has been, perhaps, after the Bible and Shakespeare more universally read than any other book; and numerous other works—chiefly romances—have furnished patterns or themes for the poets, novelists, and dramatists of other nations. Mr. *Fitz Maurice Kelly's* excellent and convenient *History of Spanish Literature* * therefore comes in good time to refresh our memories concerning these facts. One does not have to go very far in the history to find that of the great Latin writers of the age of the Cæsars, the two Senecas, Lucan the poet of Pharsalia, Martial the epigrammatist, and Quintilian the rhetorician—still an authority—and many minor writers, "were Spaniards as well as Romans." It also appears that of what Gibbon declared to have been the happiest epoch of man's history—from the death of Domitian to the accession of Commodus, seventy of the eighty years, if we take the liberty, as Mr. Kelly does, of counting Marcus Aurelius as a Cordovan, were passed beneath the scepter of the Spanish Cæsars. Prudentius, a distinguished Latin Christian writer of a succeeding age, was also a Spaniard. Although there were "archaic" works of *trovadors* before that time, traditionally preserved by *juglars*, Spanish literature proper began in the twelfth century. It owed much to French and Italian, and in course of time gave much back to them. Among its earliest signs was the development of the romance (ballad), while Arab writers (whose work Mr. Kelly considers of doubtful value) and Jews, who are better spoken of, were early contributors to it. The earliest works of importance were the Mystery of the Magian Kings, one of the first plays in any modern language, and the great heroic poem of the Cid, both anonymous. The first Castilian poet whose name has reached us was Gonzalo de Berceo, 1198 to 1264, who wrote much, and was, "if not an inventor, the chief of a school." Permanent form was given to Spanish prose by King Alfonso the Learned, 1226 to 1284, who, "like Bacon, took all knowledge for his province, and in every department shone pre-eminent." He had numerous collaborators, and "his example in so many fields was followed"—among others (in some of them) by his son and successor, Sancho IV. The Infanta, Juan Manuel, nephew of Alfonso, in one

* A History of Spanish Literature. By James Fitz Maurice-Kelly. New York: D. Appleton and Company. (Literature of the World Series. Edited by Edmund Gosse.) Pp. 423. Price, $1.50.

of the stories of his Conde Lucanor—"one of the books of the world"—created the germ of the Taming of the Shrew. Passing a numerous list of writers of respectable merit, for whose names even we have not room, we come to the age of the Catholic kings and Charles V, when for a hundred and fifty years literature most flourished in Spain. Among the features of this period are the Amadis de Gaul—"the best in that kind"—which inspired Cervantes; Columbus, who, though of Italian birth, "was probably the truest Spaniard in all the Spains," the poet Garcilaso de la Vega, and Bernal Diaz and other historians whose names dot Prescott's books. Passing a large number of writers of mark whose works appeared in this age, and stopping only to mention Alonzo de Ercilla y Zuñiga's Araucana as the first literary work of real merit composed in either American continent, we come to the age of Cervantes, whose story of Don Quixote—"the friendless people's friend," as Browning styles him—is not more distinguished for its satirical wit and humor than for its kindly humanity; and Lope de Vega, that most prolific of all dramatic authors, who "left no achievement unattempted," and died lamented by a hundred and fifty-three Spanish and fifty Italian authors, who sang his praises. Among other of the most distinguished writers of this and succeeding periods are Mariana, "the greatest of all Spanish historians"; Góngora, a famous poet in his day; Quevedo; Tirse de Molina, the creator of Don Juan; Calderon, second as a dramatist among Spaniards, if second, only to Lope de Vega, and Alarcón his compeer; and Velásquez, great in art and not small in letters. An interregnum came in during the reign of Carlos II, and French influence made itself felt. The age of the Bourbons produced among others the Benedictine Sarmiento, who as a botanist "won the admiration and friendship of Linné." The present century has been marked by the names of many authors of merit, novelists known to us in translations, by an active movement of historical composition developing brilliant monographs, and by a marked advance of scholarship and tolerance, led by Marcelino Menéndez y Pelayo; with a tendency to produce "a breed of writers of the German type."

GENERAL NOTICES.

The great importance of the problems of forestry and all that pertains to them can not fail to be appreciated by any one who has seen the devastation wrought in many sections of this country by the "wood chopper." Forestry is one of the subjects where natural science can step in and guide the way to economic success, and where, in default of scientific methods, economically fatal results inevitably ensue. The preservation of forests has been an important problem in Europe for many years, but until quite recently it has received little attention in the United States. One of the pioneers in the field of forestry in this country was Franklin B. Hough, whose Elements of Forestry is still a used and useful manual. Among his many schemes for attracting attention and study to this important subject was one of making actual sections of the wood of American trees, and arranging them in a compact and attractive manner for general distribution. This idea he never carried out, and it has remained for his son, Mr. R. B. Hough, to finally carry out the scheme, by publishing a complete series of such sections, carefully prepared and compactly bound.* In Part I of the series there are cuttings representing twenty-five species of American trees. The sections are sufficiently thin to allow of

* The American Woods. Exhibited by Actual Specimens. Part I, representing Twenty-five Species. By Romeyn B. Hough: Lowville, N. Y. The Author.

their study by transmitted light. There are three cuttings from each species, transverse, radial, and tangential to the grain. An accompanying text gives a condensed description of each tree, including its physical properties, uses, and habitat. These descriptions are preceded by a useful introduction to the study of general botany, describing the methods of distinguishing and naming the various parts of plants and trees, and giving an account of their structure and methods of growth. The actual wood sections, quite apart from their scientific value, are worthy of attention because of their great beauty. They are substantially mounted on black cardboard, each card containing the three sections of a species, and its common name in English, French, German, and Spanish. The thinness of the cuttings makes it possible to use them as transparencies, thus bringing out the texture of the wood in a very effective way.

Prof. *Charles Reid Barnes* is impressed with the fact that while laboratory work has become nearly universal in botany, and laboratory manuals are numerous, there is still a lack of books giving an elementary account of the form and functions of plants of all groups. To supply this want he offers *Plant Life* * as an attempt to exhibit the variety and progressive complexity of the vegetative body; to discuss the more important functions; to explain the unity of plan in both the structure and action of the reproductive organs; and to give an outline of the more striking ways in which plants adapt themselves to the world about them. He has made the effort to treat these subjects so that, however much the student may still have to learn, he will have little to unlearn. The book is not intended to be memorized and recited, but to be intelligible to pupils from thirteen to eighteen years of age who are engaged in genuine laboratory study under the direction "of a live teacher who has studied far more botany than he is trying to teach." It is adapted to use supplementarily to any laboratory guide or to the directions prepared by the teacher. The directions are made fullest in relation to cryptogams and physiology, because these fields are at present most unfamiliar to teachers.

Attaching great importance to *Electro-Dynamics*, which he thinks will in the near future assume the same relation to the electric motor that the science of thermo-dynamics already bears to the steam engine, Mr. *Charles Ashley Carus-Wilson* aims in the book of that name * to apply the principles of that science to the direct-current motor. Writing for electrical engineers particularly, he takes for granted a certain acquaintance with the use and design of motors, but avoids unexplained technicalities as far as possible. He has not deemed it necessary to deal with self-induction, except in connection with the question of sparking. The numerical accuracy attempted has been limited to that attainable with an ordinary ten-inch slide rule, on which all the examples have been worked out. Importance is attached to the graphic method of solution.

Of Dr. *Frank Overton's* three books on *Applied Physiology*,† the first or primary grade follows a natural order of treatment, presenting in each subject elementary anatomical facts in a manner that impresses function rather than form, and from the form described derives the function. The facts and principles are then applied to everyday life. The intermediate grade, besides being an introduction to the study of anatomy and physiology, is intended to be a complete elementary book in itself, giving a clear picture of how each organ of the body performs its work. The advanced grade book was suggested by a series of popular lectures in which the author presented the essential principles of physiology about which a physician is consulted daily. His explanations of many common facts were novel to his auditors, and it was found that the school books were silent upon many of these points, especially with regard to the cells. Throughout the series the fact that

* Plant Life considered with Special Reference to Form and Function. By Charles Reid Barnes. New York: Henry Holt & Co. Pp. 428. Price, $1.12.

* Electro-Dynamics. The Direct-Current Motor. By Charles Ashley Carus-Wilson. New York: Longmans, Green & Co. Pp. 298.

† Applied Physiology. Including the Effects of Alcohol and Narcotics. By Frank Overton, M. D. Primary Grade. Pp. 128. Intermediate Grade. Pp. 188. Advanced Grade. Pp. 432. American Book Company.

the cells are the units in which life exists and acts is emphasized. The author has endeavored to include all the useful points of the older text-books, and to add such new matter as the recent progress of physiological and hygienic science demands. Avoiding technical terms, he has sought to express the truths in simple language, "such as he would use in instructing a mother as to the nature of the sickness of her child." The subjects of alcohol and other narcotics are made prominent in all the books, and are discussed fully in the third of the series. The relation of respiration and oxidation to the disappearance of food, to the production of waste matters, and to the development of heat and force, is dwelt upon. Simple and easy demonstrations, many of them new, are provided at the ends of chapters. A chapter on Repairs of Injuries, or the restoration of the natural functions, when impaired, by the body, is new in a school text-book.

In *Yetta Ségal*,* a slender thread of a story is used by Mr. *Rollin* as the vehicle for a theory of "type fusion" or convergence which he thinks has not received sufficient attention from social or scientific students. There are a pair of lovers, one of whom is discovered at a critical period in the courtship to have negro blood in his veins, and a philosopher who comes forward to satisfy the parties (who hardly need it) that this is no serious matter, but is all according to human evolution and the destiny of the race. "You must be impressed," he says, "by the fact that there are a great many people here and there, of mixed blood, and that the number is increasing; . . . it is well that not a few are indeed truly admirable specimens of the human race. Such phenomena must be interpreted in a way consistent with man's nature: if he is developmental; if he shall attain a higher status through struggle, or through means that are seemingly, or for the time, degrading; if he is moving from the simple to the complex, as to organization; if universal movement tends to unific existence—then race interchange, with elimination of peculiar characteristics, has probably made its appearance as a phase of infinite order, and for the benefit of future man. . . . It is presumptuous for the wisest to assert that the man of lower type has no element of strength peculiar to his race which the most advanced does not need in his present organization. It may be needed either for present protection in the way of re-enforcement, or as an element of strength for further advancement." Mr. Rollin does not advocate type fusion or wish to accelerate the movement, but presents it as a fact and factor in human evolution deserving more extensive and thorough study than it has received.

* Yetta Ségal. By Horace J. Rollin. New York: G. W. Dillingham & Co. Pp. 174.

The increasing attention which of late years has been given to the study of comparative anatomy has finally resulted in what promises to be a complete and detailed account of the structure of a subhuman mammal.* The author, Dr. *Jayne*, believes that a course in mammalian anatomy offers a valuable preliminary to the study of medicine, and this is the purpose for which the book has been made. This is to a certain extent true, especially where, as in the case of the cat, there is so close a similarity to the structure of the human body. But the chief scientific interest and value of such a work must lie in its broader philosophic aspects; in the aid which it can not but give in clearing up some of the many mooted points of evolutional biology, and in the stimulus which it will impart to the study of relationships among the lower animals. The present volume, the first of the series, deals only with the skeleton of the cat, each bone being first studied individually, then in its relations to other bones and to the muscular system and the skeleton as a whole, and finally in comparison with the corresponding portion of the human skeleton. There are 611 extremely good illustrations, and the printing of the volume is unusually clean and attractive.

Among the articles of special value in recent numbers of the (bimonthly) *Bulletin of the Department of Labor*, under the editorial control of Commissioner *Carroll D. Wright* and Chief Clerk *O. D. Weaver*, are

* The Mammalian Anatomy of the Cat. By Horace Jayne, M. D. Philadelphia: J. B. Lippincott Company. Illustrated. Pp. 816. Price, $5.00.

those on Boarding Houses and Clubs for Working Women, by Mary S. Ferguson, in the March number; The Alaskan Gold Fields and the Opportunities they afford for Capital and Labor, by S. C. Durham, in the May number; Economic Aspects of the Liquor Problem; Brotherhood Relief and Insurance of Railway Employees, by E. R. Johnson, Ph. D.; and The Nations of Antwerp, by J. H. Gore, Ph.D., in the July number. Summaries of reports of labor statistics, of legislation and decisions of courts affecting labor, and of recent Government contracts constitute regular departments of the bulletin. (Washington.)

For delicate humor and refined art of expression few writers can excel Jean Paul Friedrich Richter, but the sources of his rich flow of humor are so deeply hidden and his expression is so very subtle that the generality of those who attempt to read his works fail to appreciate him or even to understand him, and give him up. The pleasure of appreciating him is, however, worth the pains of learning to do so. Those who are willing to undertake this, and who read German, may find help in the *Selections from the Works of Jean Paul Friedrich Richter*, prepared by *George Stuart Collins*, and published by the American Book Company. The book is intended for students of German who have attained a certain mastery of the language. Pains have been taken to avoid such passages as might from their mere difficulty discourage the reader, and to choose such as would be complete in themselves. The selections are made from the shorter writings of the author, and each is intended to be representative of some feature of his manifold genius and style.

A notice of the *Stenotypy*, or system of shorthand for the typewriter, of *D. A. Quinn*, was published in the Popular Science Monthly in March, 1896. It is really a system of phonography to be used with the typewriter whenever it is practicable to employ that instrument. A second edition of Mr. Quinn's manual and exercises for the practice of the system is published by the American Book Exchange, Providence, R. I.

A paper on *Polished-Stone Articles used by the New York Aborigines before and during European Occupation*, published as a Bulletin of the New York State Museum, is complementary to a previous bulletin on articles of chipped stone. Both papers are by the Rev. Dr. *W. M. Beauchamp*, and are illustrated by figures from his large collection of original drawings, made in nearly all parts of New York, but mostly from the central portion. While the chipped implements are more numerous and widespread than those treated of in the present bulletin, the latter show great patience and skill in their higher forms and taste in selecting materials, and they give hints of superstitions and ceremonies not yet thoroughly understood.

Henry Goldman has invented, in the arithmachine, what he claims is a rapid and reliable computing machine of small dimensions and large capacity, with other advantages. He now offers, as a companion to it, *The Arithmachinist*, a book intended to serve as a self-instructor in mechanical arithmetic. It gives historical and technical chapters on the calculating machines of the past, describes the principles controlling the construction and operations, and furnishes explanations concerning the author's own device. (Published by the Office Men's Record Company, Chicago, for one dollar.)

The *Bulletin from the Laboratories of Natural History of the State University of Iowa*, Vol. IV, No. 3, contains two technical articles: On the Actinaria, collected by the Bahama Expedition of the University, in 1891, by J. P. McMurrich, and the Brachyura of the Biological Expedition to the Florida Keys and the Bahamas in 1893, by Mary J. Rathbun; and a list of the coleoptera of Southern Arizona, by H. F. Wickham. Mr. Wickham observes that the insects of northern Arizona are widely different from those of the southern part, a fact which he ascribes to difference of altitude, and, consequently, in vegetation. The Bulletin is sold for fifty cents a copy.

Two books in English—*Elementary English* and *Elements of Grammar and Composition*—prepared by *E. Oram Lyte*, and published by the American Book Company, are intended to include and cover a complete graded course in language lessons, grammar, and composition for study in the primary and grammar grades of schools. The endeavor has been made to present the subject in such a way that the pupil shall become interested in the study from the first. The first book, Elementary English, is designed to furnish material for primary language work, and to show how this material can be used to advantage, embodying and representing the natural methods of language teaching. The child is given something to do—easy and practical—at every point, and is not troubled by formal definitions and rules to be committed to memory. The second book is also based on the principle that the best way to gain a working knowledge of the English language is by the working or laboratory method. It is therefore largely made up of exercises, and aims to teach through practice. The subject is unfolded from a psychological rather than a logical point of view. What is to be memorized is reduced to a minimum, and not presented till the pupil is ready for it. The lessons in literature and composition are designed to help the pupil to appreciate worth and beauty of literature, and lead him to fluent and accurate expression.

The Bulletin of the Geological Institution of the University of Upsala presents a series of special papers of much interest to students of that science, on studies in geology, largely of Scandinavia, but of other countries as well. Part 2 of Vol. III, now before us, has such papers on Silurian Coral Reefs in Gothland, by Carl Wiman; the Quaternary Mammalia of Sweden, by Rutger Sernander; Some Ore Deposits of the Atacama Desert, by Otto Nordenskiold; the Structure of some Gothlandish Graphites, by Carl Wiman; the Interglacial Submergence of Great Britain, by H. Munthe; Mechanical Disturbances and Chemical Changes in the Ribbon Clays of Sweden, by P. J. Holmquist; Some Mineral Changes, by A. G. Högborn; and the Proceedings of the Geological Section of the Students' Association of Natural Science, Upsala. The articles are in German, English, and (in previous numbers) French.

Two Spanish-American works of very different character have come to us from Valparaiso, Chili. One is entitled *Literatura Arcaica—Estudios Criticos*, or critical studies of old Spanish literature, by *Eduardo de la Barra*, of the Royal Spanish Academy, which were communicated to the Latin-American Scientific Congress at Buenos Ayres. The author was invited to present to the congress the fruits of his extensive studies on the Poem of the Cid, but afterward modified his plan and gave these, the results of his more general investigations of the romances of the fifteenth and sixteenth centuries, which Spanish critics regard as the most ancient they have, and other romances attributed to the twelfth and thirteenth centuries, with an article on the Cid. This work is published by K. Newman, Valparaiso.

The other book is a volume of *Rrimas*, or rhymes, by Gustabo Adolfo Béker, published by Carlos Cabezon, at Valparaiso. The ordinary student might think that the Spanish language is one of those least in need of spelling reform, but not so the author and publisher of these poems, which are presented in the most radically "reformed" spelling, and with them comes a pamphlet setting forth the character and principles of "Ortografia Rrazional."

The report of a study of seventy-three Irish and Irish-American criminals made at the Kings County Penitentiary, Brooklyn, N. Y., by Dr. *H. L. Winter*, and published as *Notes on Criminal Anthropology and Bio-Sociology*, contains numerous observations bearing upon the effect of hereditary influences in criminality, but hardly sufficient to justify the drawing of any general conclusions.

The late Mr. Lewis M. Rutherfurd, in developing the art of astronomical photography, naturally gave much attention to the star 61 Cygni—which was the first to yield its parallax, and through which the possibility of measuring stellar distances was shown—and its neighbors. A number of the plates of this series were partially studied by Miss Ida C. Martin more than twenty years ago, and the study has now been carried out by *Herman S. Davis*, as part of the work of Columbia University Observatory. The results of Mr. Davis's labors are published by the observatory in three papers: *Catalogue of Sixty-five Stars near 61 Cygni; The Parallaxes of* 61^1 *and* 61^2 *Cygni;* and *Catalogue of Thirty-four Stars near "Bradley 3077"*; under a single cover.

In a small work entitled *A Theory of Life deduced from the Evolution Philosophy* a few thoughts are recorded by *Sylvan Drey* relative to the manner in which, from central doctrines identical with the teachings of Herbert Spencer, a system of religion, an ideal society, a theory of ethics, and a political creed—the doctrine of social individualism—may be built up. The religion is to recognize an inexplicable and inconceivable energy revealing itself in the universe, of which the highest theistic conception possible to human beings, free from the supposition that it represents a likeness, is the only one that can be accepted. "Absolute truth is beyond the grasp of human beings; but for all practical purposes the teachings of the evolution philosophy, relative truths though they may be, may be regarded as final and conclusive." Mr. Drey's paper of thirty-four pages is published by Williams & Norgate, London.

PUBLICATIONS RECEIVED.

Adams, Alexander. Mechanical Flight on Beating Wings. The Solution of the Problem. Pp. 5.

Agricultural Experiment Stations. Bulletins and Reports. New York: No. 143. A Destructive Beetle and a Remedy. By P H. Hall and V. H. Lowe; No. 144. Combating Cabbage Pests. By F. H. Hall and F. A. Sirrine. Pp. 8.—Ohio: Newspaper, No. 186. Peach Yellows and Prevention of Smut in Wheat. Pp. 2; No. 24. The Maintenance of Fertility. Pp. 42.—United States Department of Agriculture: No. 9. Cuckoos and Shrikes in their Relation to Agriculture. By F. E. L. Beal and Sylvester D. Judd. Pp. 25; No. 10. Life Zones and Crop Zones of the United States. By C. Hart Merriam. Pp. 79; No. 11. The Geographic Distribution of Cereals in North America. By C. S. Plumb. Pp. 24; Division of Statistics: Crop Circular for October, 1898.—University of Illinois: No. 51. Variations in Milk and Milk Production. Summary. Pp. 40; No. 52. Orchard Cultivation. Pp. 24; No. 53. Abstract. The Chemistry of the Corn Kernel. Pp. 4.

Allen, Alfred H. Commercial Organic Analysis. Second edition, revised and enlarged. Proteids and Albuminous Principles. Philadelphia: P. Blakiston's Son & Co. Pp. 584. $4.50.

Atkinson, George Francis. Elementary Botany. New York: Henry Holt & Co. Pp. 444. $1.25.

Bulletins, Proceedings, and Reports. American Chemical Society: Directory. Pp. 551.—Field Columbian Museum, Chicago. Publication 28: Ruins of X Kichmook, Yucatan. By Edward H. Thompson. Pp. 16, with 18 plates.—Lake Mohonk Conference on International Arbitration: Report of the Fourth Annual Meeting, 1898. Pp. 116.—Maryland Geological Survey: Report on the Survey of the Boundary Line between Alleghany and Garrett Counties. By L. A. Bauer. Pp. 48, with 6 plates.—New York Academy of Sciences: Annals. Vol. X. Pp. 292, with 5 plates; Vol. XI, Part II. Pp. 168, with 20 plates.—Pennsylvania Society for the Prevention of Tuberculosis: Report for the Year ending April 13, 1898. Pp. 16.—The Philadelphia Museums: The Philadelphia Commercial Museum. Pp. 16.—United States Commissioner of Labor: Twelfth Annual Report, 1897. Economical Aspects of the Liquor Problem. Pp. 275.—University of Wisconsin: Bulletin No. 25. The Action of Solutions on the Sense of Taste. By Louis Kahlenberg. Pp. 32.—University of Chicago: Anthropology. III. The Mapa de Cuauhtlantzinco or Codice Campos. By Frederick Starr. Pp. 38, with plates.—University of Illinois: The New Requirements for Admission. By Stephen A. Forbes. Pp. 22.

Bailey, L. H. Sketch of the Evolution of our Native Fruits. New York: The Macmillan Company. Pp. 472. $2.

Beddard, Frank E. Elementary Zoölogy. New York: Longmans, Green & Co. Pp. 208.

Brush, George J., and Penfield, Samuel L. Manual of Determinative Mineralogy, with an Introduction on Blowpipe Analysis. New York: John Wiley & Sons. Fifteenth edition. Pp. 312.

Bryant, William M. Life, Death, and Immortality, with Kindred Essays. New York: The Baker & Taylor Company. Pp. 450. $1.75.

Carborundum manufactured under the Acheson Patents. Illustrated Catalogue. Niagara Falls, N. Y.: The Carborundum Company. Pp. 61.

Carnegie, The, Steel Company, Limited, Pittsburg. Ballistic Tests of Armor Plate. By W. R. Balsinger. Plates and letterpress descriptions.

Dana, Edward Salisbury. A Text-Book of Mineralogy, with an Extended Treatise on Crystallography and Physical Mineralogy. New York: John Wiley & Sons. Pp. 593. $4.

Darwin, George Howard. The Tides and Kindred Phenomena in the Solar System. Boston and New York: Houghton, Mifflin & Co. Pp. 378. $2.

Giddings, Franklin Henry. The Elements of Sociology. New York: The Macmillan Company. Pp. 353. $1.10.

Guerber, H. A. The Story of the English. American Book Company. Pp. 356.

Hough, Romeyn B. The American Woods. Exhibited by Actual Specimens and with Copious Explanatory Text. Part I. Representing twenty-five species. Second edition. Lowville, N. Y.: The author. Pp. 78, text.

James, William. Human Immortality. Two Supposed Objections to the Doctrine. Boston and New York: Houghton, Mifflin & Co. Pp. 70. $1.

Kunz, George F. The Fresh-Water Pearls and Pearl Fisheries of the United States. United States Fish Commission. Pp. 52, with 22 plates.

Le Bon, Gustave. The Psychology of Peoples. New York: The Macmillan Company. Pp. 236. $1.50.

Miller, Adam. The Sun an Electric Light, Chicago. Pp. 32.

Needham, James G. Outdoor Studies. A Reading Book of Nature Study. American Book Company. Pp. 90.

Newth, G. S. A Manual of Chemical Analysis, Qualitative and Quantitative. New York: Longmans, Green & Co. Pp. 462. $1.75.

Nipher, Francis E. An Introduction to Graphical Algebra. New York: H. Holt & Co. Pp. 61. 60 cents.

Reprints. Gifford, John. Forestry on the Peninsula of Eastern Virginia. Pp. 3; Forestry in Relation to Physical Geography and Engineering. Pp. 19.—Hester, C. A. An Experimental Study of the Toxic Properties of Indol. Pp. 26, with tables.—Hoffmann, Fred. Fragmentary Notes from the Reports of Two Early Naturalists on North America. Pp. 18.—Johnson, J. B. A Higher Industrial and Commercial Education as an Essential Condition of our Future Material Prosperity. (An address.) Pp. 33.—Kain, Samuel W., and Others. Seismic and Oceanic Noises. Pp. 6.—Mayer, Hermann. Bows and Arrows in Central Brazil. Pp. 36, with plates.—Packard, Alpheus S. A Half Century of Evolution, with Special Reference to the Effect of Geological Changes on Animal Life. (Presidential address to American Association.) Pp. 48.—Rhees, William J. William Bower Taylor. Pp. 12.—Searcy, J. T., M. D. How Education fails. Pp. 81.—Shufeldt, R. W., M. D. On the Alternation of Sex in a Brood of Young Sparrow Hawks. Pp. 4.—Starr, Frederick. Notched Bones from Mexico. A Shell Inscription from Tula, Mexico. Pp. 10.—Woolman, Lewis. Report on Artesian Wells in New Jersey, etc. Pp. 84.

Smithsonian Institution. United States National Museum. The Fishes of North and Middle America. By D. S. Jordan and B. W. Evermann. Part II. Pp. 942.—The Birds of the Kurile Islands. By Leonhard Stejneger. Pp. 28.—On the Coleopterous Insects of the Galapagos Islands. By Martin L. Linell. Pp. 20.—On Some New Parasitic Insects of the Subfamily Encystinæ. By L. O. Howard. Pp. 18.—Descriptions of the Species of Cycadeoidea, or Fossil Cycadean Trunks, thus far determined from the Lower Cretaceous Rim of the Black Hills. By Lester F. Ward. Pp. 36.

Socialist, The, Almanac and Treasury of Facts. New York: Socialistic Co-operative Publishing Association. Prepared by Lucien Sanal. Pp. 232. (The People's Library. Quarterly. 60 cents a year.)

Thompson, Ernest Seton. Wild Animals I have known. and Two Hundred Drawings. New York: Charles Scribner's Sons. Pp. 359. $2.

Todd, Mabel Loomis. Corona and Coronet. Being a Narrative of the Amherst Eclipse Expedition to Japan, 1896, etc. Boston and New York: Houghton, Mifflin & Co. Pp 383. $2.50.

Trowbridge, John. Philip's Experiments, or Physical Science at Home. New York: D. Appleton and Company. Pp. 228. $1.

United States Geological Survey. Bulletin No. 88. The Cretaceous Foraminifera of New Jersey. By R. M. Bagg, Jr. Pp. 89, with 6 plates.—No. 89. Some Lava Flows from the Western Slope of the Sierra Nevada, California. Pp. 74.—No. 149. Bibliography and Index of North American Geology, Palæontology, Petrology, and Mineralogy for 1898. By F. B. Weeks. Pp. 152.—Monograph. Vol. XXX. Fossil Medusæ. By Charles Doolittle Walcott. Pp. 201, with 47 plates.

Universalist Register, The, for 1898. Edited by Richard Eddy, D. D. Boston: Universalist Publishing House. Pp. 120. 20 cents.

Warman, Cy. The Story of the Railroad. New York: D. Appleton and Company. (Story of the West Series.) Pp. 280.

Waterloo, Stanley. Armageddon. A Tale of Love, War, and Invention. Pp. 259.

Whiting Paper Company, Holyoke, Mass. The Evolution of Paper. Pp. 20. Chicago and New York: Rand, McNally & Co.

Wilson, J. Self-Control, or Life without a Master. New York: Lemcke & Büchner.

Worcester, Dean C. The Philippine Islands and their People. New York: The Macmillan Company. Pp. 529. $4.

Wyckoff, Walter A. The Workers. An Experiment in Reality. The West. New York: Charles Scribner's Sons. Pp. 378. $1.50.

Fragments of Science.

Tree Planting in the Arid Regions.—In planting the arid and subarid regions of the country, where no trees are growing naturally, Mr. B. E. Fernow says, in a review of the work of the Department of Forestry, different methods of cultivation from those given in the humid parts are necessary, and the plant material has to be selected with a view to a rigorous climate characterized by extreme ranges of temperature varying from $-40°$ to $+120°$ F. The requirements of the plants for moisture must be of the slightest, and they must be capable of responding to the demands of evaporation. At first, whatever trees will grow successfully from the start under such untoward conditions would have to be chosen, no matter what their qualities otherwise might be. The first settlers have ascertained by trials some of the species that will succeed under such conditions, but unfortunately most of them are of but small economic value, and some of them are only short-lived under the conditions in which they have to grow. A few years ago Mr. Fernow came to the conclusion that the conifers, especially the pines, would furnish more useful and otherwise serviceable material for the arid regions. Besides their superior economical value, they require less moisture than most of the deciduous trees that have been planted, and they would, if once established, persist more readily through seasons of drought and be longer lived. A small trial plantation on the sand hills of Nebraska lent countenance to this theory. It being vastly more difficult to establish the young plants in the first place than in the case of deciduous trees, much attention was given to the provision for protection of the seedlings from sun and winds; and they were planted in mixture with "nurse trees" that would furnish not too much and yet enough shade. "It can not be said that the success in using these species has so far been very encouraging; nevertheless, the failure may be charged rather to our lack of knowledge and to causes that can be overcome than to any inherent incapacity in the species." The experiments should therefore be continued.

"The Venerable Bede's" Chair.—In an article in a recent issue of Architecture and Building, on Ancient and Modern Furniture, by F. T. Hodgson, the following interesting account of the chair of "the Venerable Bede" occurs: "Perhaps the best-known relic, so far as furniture is concerned of this early period, is the chair of 'the Venerable Bede,' which is still preserved in the vestry of Jassova Church, Northumberland, England. This chair is distinctively an ecclesiastical one—a throne, in fact, of some dignity. It is made of oak and is four feet ten inches high. There are many engravings of it, but I reproduce from one of the best. The chair is now well on to twelve hundred years old, and if cared for as it ought to be is good for several hundred years more. There is a popular tradition concerning this chair that is worthy of notice It is said that to this ancient relic all the brides repair as soon as the marriage service is over, in order that they may seat themselves in it. This, according to the popular belief, will make them joyful mothers of children; and to omit this custom the expectant mothers would not consider the marriage ceremony complete, and in default thereof of being enthroned in 'the Venerable Bede's chair' barrenness and misery would surely follow. Like all other relics of the sort, it is subject to attacks of the sacrilegious penknives, together with the wanton depredations of relic hunters, and has been so shorn of its fair proportions that very soon there will be little of it left but its attenuated form if stricter watch is not kept over it."

The Physics of Smell.—The principal subject of Prof. W. E. Ayrton's vice-presidential address on physics at the British Association was the physics of smell, which was presented as a subject that had been but little studied. In testing the generally accepted idea that metals have smell, based on the fact that a smell is perceived with most of the commercial metals when handled, the author had observed that when these metals were cleaned or made outwardly pure the smell disappeared. Yet it is shown that these metals acquire smells when they are handled or abraded by friction, which are characteristic and serve to distinguish them. This may be ascribed to chemical action, but not all chemical action in which metals may take part produces smell; for when they are rubbed with soda or with sugar no smell but that of soda or of sugar is perceived; nor is the metallic smell observed when dilute nitric acid is rubbed on certain metals, though the chemical action is very marked with some. But mere breathing on certain metals, even when they have been rendered practically odorless by cleaning, produces a very distinct smell, as also does touching them with the tongue. These smells have hitherto been attributed to the metals themselves, but Professor Ayrton looks for their source in the evolution of hydrogen, which carries with it impurities, hydrocarbons, especially paraffin, and "it is probable that no metallic particles, even in the form of vapor, reach the nose or even leave the metal. While smells usually appear to be diffused with great velocity, experiments prove that when the space through which they have to pass is free from draughts their progress is very slow, and it would therefore appear that the passage of a smell is far more due to the actual motion of the air containing it than to the diffusion of the odoriferous substance through the air." The power of a smell to cling to a substance does not appear to depend on its intensity or on the ease with which it travels through a closed space. Experiments to determine whether smells could pass through glass by transpiration either revealed flaws in the glass or ended in the breaking of the very thin bulbs and gave no answer.

The Cordillera Region of Canada.—A length of nearly thirteen hundred miles of the great mountainous or Cordillera region of the Pacific coast is included in the western part of Canada. Most of this, Mr. George M. Dawson says, in a paper on the Physical Geography and Geology of Canada, is embraced in the province of British Columbia, where it is about four hundred miles wide between the Great Plains and the Pacific Ocean. To the north it is included in the Yukon district of the Northwest Territory till it reaches, in a less elevated and more widely spread form, the shores of the Arctic Ocean on one side and on the other passes across the one hundred and forty-first meridian of west longitude into Alaska. The orographic features of this region are very complicated in detail. No existing map yet properly represents even the principal physical outlines, and the impression gained by the traveler or explorer may well be one of confusion. There are, however, the two dominant mountain systems of the Rocky Mountains and the Coast Range. As a whole, the area of the Cordillera in Canada may be described as forest-clad, but the growth of trees is more luxuriant on the western slopes of each of the dominant mountain ranges, in correspondence with the greater precipitation occurring on these slopes. This is particularly the case in the coast region and on the seaward side of the Coast Range, where magnificent and dense forests of coniferous trees occupy almost the whole available surface. The interior plateau, however, constitutes the southern part of a notably dry belt, and includes wide stretches of open grass-covered hills and valleys, forming excellent cattle ranges. Farther north, along the same belt, similar open country appears intermittently, but the forest invades the greater part of the region. It is only toward the arctic coast, in relatively very high latitude, that the barren arctic tundra country begins, which, sweeping in wider development to the westward, occupies most of the interior of Alaska. With certain exceptions the farming land of British Columbia is confined to the valleys and tracts below three thousand feet, by reason of the summer frosts occurring at greater heights. There is, however, a considerable area of such land in the aggregate, with a soil generally of great fertility. In the southern valleys of the interior irrigation is necessary for the growth of crops.

The "Rabies" Bacillus.—Ever since the discovery of Pasteur that an attenuated virus made from the medulla or spinal cord of a dog affected by rabies was, when administered in graduated doses, a specific against the disease, bacteriologists have been eagerly seeking to isolate the rabies bacillus. A number of observers, among them Toll, Rivolta, and San Felice, have succeeded in staining a bacillus which they claimed to be that of rabies. Memno, of Rome, confirmed the observations of the preceding, and proved the virulent character of the microorganism, which he described as a blastomycete. He has quite recently succeeded in cultivating the bacillus in artificial media and producing typical rabies in dogs, rodents, and birds by inoculations. He found that the bacillus grew better in fluid than in solid media, the best being bouillon with glucose slightly acidulated with tartaric acid. The growth did not become manifest under a week, and was easily arrested by "air infection." It would thus seem that we have at last certainly established the bacterial origin of rabies.

The St. Kildans.—St. Kilda, the farthest out to sea of all the British Isles, is a rounded mountain with "stack rocks" and islets round it, rises twelve hundred and twenty feet in height, and contains a settlement of about seventy-five men, women, and children—almost the only representatives left on the British Islands of man in the hunting age. On one of the subsidiary islands, Boreray, is gathered the main body of the sea birds for which the island is famous; and on a third, Soa, are the diminutive descendants of Viking sheep, left by old sea rovers. Mr. R. Kearton, who has recently visited the islands for recreation among the sea birds, represents that in the little community of its people the ordinary and extraordinary operations of life seem inverted. Sport is a serious work; sheep herding and shearing are an exciting sport. A St. Kildan qualifies for marriage by proving his courage and skill as a fowler, by standing on a dizzy precipice called Lover's Stone, and goes out bird snaring with a serious face. When he wants a sheep for the butcher, he asks his friends to a sheep hunt in the island of Soa, in which dogs and men pursue the animals from rock to rock. An offer made by a factor to supply the people with nets, so that they might catch the sheep with more humanity and less waste of life, was rejected by them. They preferred the old methods, which supplied plenty of danger and excitement. While the sheep are hunted, the cows are thoroughly spoiled. Every day the women are seen hard at work picking dock leaves and storing them in baskets for the cows at milking time, for they will not be milked unless they are fed. The sheep on Soa Island are plucked instead of being sheared, at the time when the wool would naturally be shed, and what wool will not come off in this way is cut off with a pocket knife. When the steamer with Mr Kearton reached the island, no one came down to meet it till the whistle had been blown two or three times. "It was not etiquette to rush down like a parcel of savages," but the people "retire to tidy themselves, and then row out and call in proper form."

The Island of Sakhalin.—Mr. Benjamin Howard, an English visitor at the recent meeting of the American Association for the Advancement of Science, presented before Section E of that body an interesting account of the great but little-known island of Sakhalin, more generally spelled Saghalien in our geographies. Mr. Howard, however, strongly urged the former spelling, as most correctly representing the name, which is always pronounced by the Russians in three syllables, with the accent on the first. It is now used as a penal colony by the Russian Government, and a more hopelessly remote and inaccessible spot for such a purpose can hardly be found. To it are sent the hardest cases among the Siberian prisoners; and Mr. Howard spoke of becoming accustomed, during his stay there, to meeting scarcely any human beings but murderers, except, of course, the guards and officials. The island is extremely inaccessible; there is no commerce, and neither inducement nor opportunity for vessels to touch there, while much of the coast is ice-bound for a large part of the year. Mr. Howard, who was engaged in some scientific work on the island in the service of the Government, is one of the very few foreigners who have traveled or resided there at all. He predicts for Sakhalin, however, a future of considerable importance ultimately, though only after a long period of preliminary development and exploitation as a penal colony, which stage has but lately been begun. It has forest and mining resources—among the latter, coal; the deposits are near the surface, but thus far have been very little examined. He was unable to give any data as to their geological age or actual extent; but the Government will no doubt soon make investigations. The most remarkable possibilities, however, are in the line of fisheries, the coasts swarming with fish to an extent that is scarcely credible by one who has not seen them. Mr. Howard said jocosely that he would hardly dare to relate what he had personally witnessed, in view of the usual reputation of "fish stories." The climate is of course rigorous, under the influence of cold northern currents, and markedly in contrast with that of the same latitude on the American side of the Pacific, where the Japan current carries its modifying influence as the Gulf Stream does to northern Europe. Some agriculture, however, is possible during the short summer, and the penal colonists have made fair beginnings of self-support. He referred further to a remnant of native Aino population as very interesting from the fact that they have preserved their peculiarities of life and manners, and their purity of stock, much more completely through their isolation than the Ainos of the Japanese Islands, who have been modified more or less by association with the latter people.

Technical and Popular Names.—In a paper criticising the multiplication of local names in geology, Prof. C. E. Keyes distinguishes between names devised with a conscientious desire to better the condition of a science by clothing the new ideas with simple words and those which are the product of a name-making mania. "The first can not be too highly commended, nor the second too deeply deplored." Every progressive science must discard the names that have served their purpose, and must be prepared to receive all of the new ones demanded. The sciences have each two phases, for each of which a terminology is demanded, in one of which the names must be technical and special, established primarily for the investigator, and in the other general, popular, simple, and free from technical appearance; but the distinction is rarely made. Those who object to the prevalence of technical names in other sciences seldom reflect that they have them in their own art. Yet if a man of science should desire to familiarize himself with the artisan's work, "he would be, after five minutes' talk with a machinist or electrician, confronted by so many unfamiliar terms—technical terms of everyday use—that he would at once cry out for greater simplicity of language." In the geological sciences the technicalities play the same part they do in the arts and in business. Every new name in geology, however, must be properly defined before it can be noticed, and its subsequent career will depend on its utility. It may be said that no greater boon to the working geologist has been devised than the plan of designating geographically geological units irrespective of exact position or age. Since its adoption a vast mass of valuable information has been obtained that was previously unthought of, and is in a shape to be always used; the other departments of geology have been much aided, and stratigraphical geology has been greatly helped.

The Origin of a Curious Habit.—The following paragraphs are taken from a recent Nature. It is well known that the kea, or mountain parrot of New Zealand, has acquired the habit of attacking sheep, and making holes by means of its sharp and powerful beak in the backs of these animals for the purpose of abstracting the kidney fat, which appears to be esteemed as a luxurious diet. It is supposed that this peculiar habit or instinct was developed by the bird getting the fat from the skins of sheep that had been slaughtered, but this solution is not very satisfactory, as there appears nothing to connect the fat on the skins of sheep with the live animals. In a note published in the Zoölogist (May 16th), Mr. F. R. Godfrey, writing from Melbourne, offers the following solution of the mystery, which seemed to him to be simple and satisfactory, and more rational than the skeepskin theory: In the hilly districts of the middle island of New Zealand there is a great abundance of a white moss, or lichen, which exactly resembles a lump of white wool, at the roots of which are found small white fatty substances, supposed by some to be the seeds of the plant, and by others to be a grub or maggot which infests it, which is the favorite food of the kea. Probably the bird, misled by this resemblance, commenced an exploration in sheep, and this proving satisfactory, originated the new habit. In a note to this suggestion the editor points out that Mr. Godfrey is in agreement with another observer—Mr. F. R. Chapman—who in describing the hills of this island says: "A very interesting *raoulia*, or vegetable sheep, was very plentiful on steep, rocky places. . . . It is said that the keas tear them up with their powerful beaks, and that these birds learned to eat mutton through mistaking dead sheep for masses of *raoulia*."

Changes in Plant Characters.—From experiments upon the cultural evolution of *Cyclamen latifolium*, W. T. Thiselton Dyer finds that, when once specific stability has been broken down in a plant, morphological changes of great variety and magnitude can be brought about in a comparatively short space of time. It appears that though sudden variations do occur, they are, as far as we know, slight as long as self-fertilization is adhered to. The striking results obtained by cultivators have been due to the patient accumulation by selection of gradual but continuous variation in any desired direction. The size which any variable organ can reach does not appear to be governed by any principle of correlation. Large flowers are not necessarily accompanied by large leaves. The general tendency of a plant varying freely under artificial conditions seems to be atavistic—or to shed adaptive modifications which have ceased to be useful, and to revert to a more generalized type, or to reproduce characters which are already present in other members of the same group. But this statement must be accepted with caution. The most remarkable phenomenon in the cultivation of the *Cyclamen* is the development of a plume or crest on the inner surface of each corolla segment. This shows that the plant still possesses the power to strike out a new line and to develop characters which would even be regarded as having specific value.

Hanging an Elephant.—One of the elephants in Barnum and Bailey's show, having repeatedly shown signs of insubordination and bad temper, it was finally decided to kill him. From a note in Nature we get the following account of his execution: After considerable discussion it was decided to strangle him. A new Manila rope was loosely wound three times around his neck, and his legs, fully stridden, were securely chained each to a post firmly driven into the ground alongside each limb. The animal was intentionally not isolated from his fellows, as it was feared that if placed by itself it would become restive and ill-tempered. The rope surrounding the beast's neck had one end secured to three strong pillars in the ground, some distance away and slightly in advance of the fore feet; and the other, which terminated in a loop, was hooked to a double series of pulleys, to the tackle of which ninety men were attached. When all was ready, the slack was gently, quietly, and without any apparent annoyance to the elephant—which kept on eating hay—taken in till the coils round its neck were just taut. The word was then given, "Walk away with the rope." Amid perfect silence the ninety men walked away, without apparently any effort. So noiselessly and easily did everything work that, unless with foreknowledge of what was going to take place, one might have been present without realizing what the march of these men meant. The elephant gave no sign of discomfort either by trunk or tail. Its fellows standing close by looked on in pachydermatous unconcern, and at the end of exactly thirty seconds it slowly collapsed and lay down as if of its own accord. There was absolutely no struggle and no motion, violent or otherwise, in any part of the body, nor the slightest indication of pain. In a few seconds more there was no response obtained by touching the eyeball. At the end of thirteen minutes after the order to "walk away" the eye had become rigid and dim. That no more humane, painless, and rapid method of taking the life of a large animal could be devised was the opinion of all the experts who witnessed the execution.

MINOR PARAGRAPHS.

Count Gleichen relates, in his story of the mission to Menelek, that besides the Maria Theresa 1780 dollars, the people of Abyssinia, for small change, use a bar of hard crystallized salt, about ten inches long and two inches and a half broad and thick, slightly tapered toward the end, five of which go to the dollar at the capital. People are very particular about the standard of fineness of the currency. "If it does not ring like metal when flicked with the finger nail, or if it is cracked or chipped, they won't take it. It is a token of affection also, when friends meet, to give each other a lick of their respective *amolis*, and in this way the material value of the bar is also decreased. For still smaller change cartridges are used, of which three go to one salt. It does not matter what sort they are. Some sharpers use their cartridges in the ordinary way, and then put in some dust and a dummy bullet to make up the difference, or else they take out the powder and put the bullet in again, so that possibly in the next action the unhappy seller will find that he has only miss-fires in his belt; but this is such a common fraud that no one takes any notice of it, and a bad cartridge seems to serve as readily as a good one."

A study of problems in the Psychology of Reading, by J. O. Quantz, bore upon the questions of the factors which make a rapid reader, the relations of rapidity to mental capacity and alertness, quickness of visual perception, and amount of practice; and whether those who gain their knowledge principally through the eye or through the ear obtain and retain most from reading. The author finds that colors are more easily perceived than geometrical forms, isolated words than colors, and words in construction than disconnected words; that persons of visual type are slightly more rapid readers than those of the auditory type; that rapid readers, besides doing their work in less time, do superior work, retaining more of the substance of what is read and heard than do slow readers. Lip movement is a serious hindrance to speed, and consequently to intelligence, of reading. The disadvantage extends to reading aloud. Apart from external conditions, such as time of day, physical fatigue, etc., some of the influences contributing to rapidity of reading are largely physiological, as visual perception; others are of mental endowment, as alertness of mind; still others are matters of intellectual equipment rather than intellectual ability, as extent of reading and scholarly attainment.

Mr. Merton L. Miller, of the University of Chicago, says, in his preliminary study of the Pueblo of Taos, New Mexico, that he was hampered in his researches there by a circumstance that illustrates very well certain characteristics of the Indian. About fifteen years ago representatives of the Government were at Sia making investigations, and had to ask many questions. Some time after they went away there was much sickness in the pueblo, and many people died. It occurred to the Sia people that the presence of those white men, asking so many questions, was the cause of all their trouble; so they sent men to the other pueblos to warn them against white men who came to find out about their customs and beliefs. These messengers also came to Taos, and the people remembered their warning well. If a Taos Indian is caught now teaching the language or telling any of the traditions to a white man, he is liable to a whipping and a fine. This, Mr. Miller believes, accounts for the fact that he could rarely learn anything from his friend when they were at the pueblo, although when away in the mountains he became much more open and communicative.

NOTES.

The cigarette has found friends. The Truth about Cigarettes embodies the substance of papers read and discussed at the Medico-legal Society of New York. The gist of the papers is to the effect that the stories of harm done by cigarettes are fictions or gross exaggerations; that they contain no opium, arsenic, or other poisons, but are the best pure tobacco (1.0926 grammes each) wrapped in pure paper (0.038 gramme); that they never caused a case of insanity; and that they are simply injurious in the same way and to a corresponding extent as other forms of tobacco. These statements are supported by certificates of physicians and by reviews of special cases of insanity charged to cigarettes, showing that the insanity had matured independently of them.

The average annual temperature at Manila is given by Mr. W. F. R. Phillips, in a paper on the subject, as 80° F. April, May, and June are the hottest months, May being the hottest of the three, and December and January are the coolest. The highest thermometer reading recorded is 100° F. in May, and the lowest 74° in January. The average annual rainfall is 75.43 inches, more than 80 per cent of which descends in the months from June to October, inclusive. Departures from the average rainfall are sometimes excessive. For example, as much as 120.98 inches have fallen in one year, and as little as 35.65 inches in another. Still more remarkable were the fall of 61.43 inches in one September, and that of only two inches in another September.

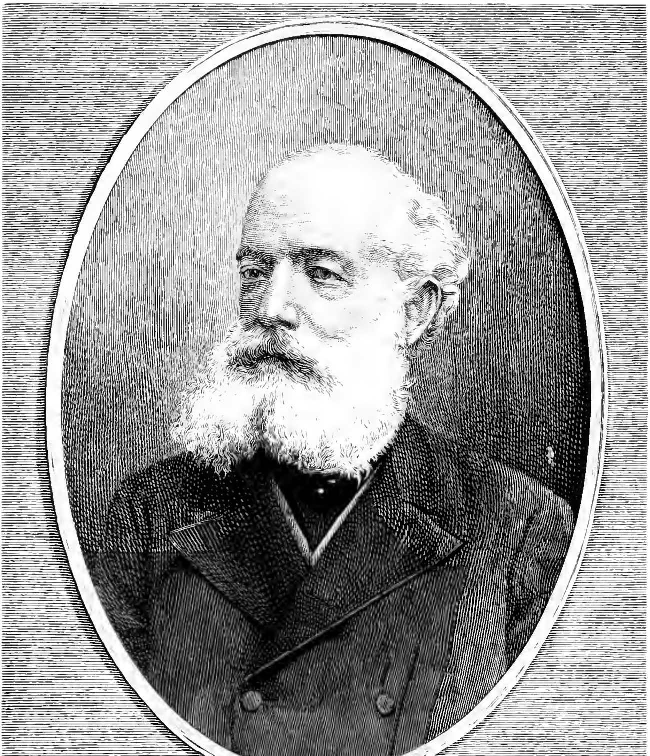
At the observatory of Yale University, as we learn from the annual report, a planned series of twelve measures each has been completed for eighty-four stars of large, proper motion, with a view to determinations of parallax, and it is expected shortly to bring the number up to one hundred. A series of measures on highly colored red stars has been begun, and is in progress for the purpose of testing the possibility of a systematic error due to the lesser refrangibility of their light. The photographic instrument has been put into use at every suitable period of meteorological displays of consequence. Preparations are already making for a more complete observation of the Leonid meteoric shower expected in 1899.

The New York State College of Forestry, in connection with Cornell University, was presented by Professor Fernow, at the Boston meeting of the American Association, as a logical sequence to the policy to which the State of New York was committed in 1885 by the purchase of more than a million acres of forest land in the Adirondack Mountains, to be gradually increased to three million acres. A demonstration area of thirty thousand acres in the Adirondacks has since been provided for it. The courses leading to the degree of Bachelor in Forestry occupy four years, of which the first two are devoted to the studies in which mathematics, physics, chemistry, geology, botany, entomology, political economy, etc., figure as fundamental and supplementary sciences, in addition to the professional courses; besides which two courses of a more or less popular character are contemplated.

The discovery is announced in a preliminary communication by Dr. Issutschenko, of Russia, of a microbe pathogenic to rats. An epidemic having broken out among the rats kept for experimental purposes in the Government Agricultural Laboratory, a bacillus was isolated from the liver and spleen of affected animals that proved excessively fatal to rats and mice. Experiments in making the organism useful as a living rat poison have not yet, however, had an encouraging success.

New Zealand has just definitely adopted a scheme of old-age pensions. In future the New Zealand workingman of sixty-five years of age, who has lived a life of honest toil, will be assured an income of one pound a week.

The Wilde prize of the French Academy of Sciences has been awarded by that body to Charles A. Schott, chief of the Computation Division of the United States Coast and Geodetic Survey, for his work on Terrestrial Magnetism.



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THE EVOLUTION OF COLONIES.

By JAMES COLLIER.

VI.—INDUSTRIAL EVOLUTION.

THE earliest nomadic stage of mankind has left traces in many of the colonies. The first age of French Canada, of New York, of great pa.t of North America, was one of hunters and trappers, and it has continued in the Northwest till recent times. The first brief period of Rhodesia was that of the big-game hunter. The Boers of the Transvaal are still as much hunters as farmers. The American backwoodsman who clears a patch, then sells his improvements to the first newcomer, and, placing his wife and children and scanty belongings on a cart, proceeds *da capo* elsewhere, is a nomadic pioneer. The stage is in one way or another perpetual, for the class never quite dies out. The drunken English quarryman who, driven by a demon of restlessness, continually goes "on tramp," and in his wanderings covers on foot a space equal to twice the circumference of the globe, is a demi-savage whose nomadism is only checked by the "abhorred approaches of old age." If he emigrates, he repeats the old, wild life as a pick-and-shovel man in Queensland or a quarryman in New South Wales. The soberer colonial youth, who more luxuriously canters from farm to farm in New Zealand on the back of a scrub, is a tamer specimen who settles down when he marries. Nay, the "restless man" who periodically applies for leave of absence from a colonial legislature in order to travel in India, China, and Timbuctoo, is a still milder but not less incorrigible example of the same indestructible type.

The pastoral stage is all but universal. Wherever grass grows (and there is wild grass almost everywhere) sheep can graze, and where there are succulent twigs cattle will fatten on them. The South American *estancias* and the ranches of Colorado, the cattle runs of Queensland and northern New Zealand, the sheep runs of Victoria and New South Wales repeat and perpetuate this stage. The genesis of it may even now be daily observed. A Manchester accountant who has never before been astride a horse will in twelve months learn the mysteries of cattle and sheep farming, then purchase a hundred acres or two from the colonial Government, gradually clear it of timber, build of his own trees, with no skilled assistance, a weatherboard cottage, and take home a swiftly wooed wife to lead with him a rather desolate existence in "the bush." Or (on a larger scale) a squatter,* who is commonly a gentleman by birth and education, comes out from England with inherited wealth, buys or leases from the Government a large inland tract of grazing land, takes with him flocks and herds, shepherds and stockmen, builds a bark or wooden manor house, and settles down to the life of Abram on the plains of Mamre. In earlier days, when the colony was in its infancy, he would not have had to purchase or lease his "run." One country after another saw the golden age of a would-be landed aristocracy. As Norman William parceled out all England among his nobles and knights, rulers of conquered countries were then mighty free with what did not belong to them. Possessing the authority of a sovereign, Columbus made lavish grants of land, and thus pacified his rebels. Charles II presented Carolina to eight proprietors. Baronies of twelve thousand acres in South Carolina, manors of twenty thousand acres in Maryland, were dwarfed by territorial principalities of more than a million acres in New York. The absolute governors of early Australia gave away wide tracts. When land was not given it was taken, on Rob Roy's principle. During the interregnum that followed the recall of the first Governor of New South Wales, military robbers seized fifteen thousand acres, and under subsequent administrations they continued their depredations. Land was held on various tenures. The first American forms were varieties of belated feudalism; of a hundred often strange and ridiculous emblems of suzerainty perhaps a dozen repeated Old World customs.† Sir H. S. Maine has proved that nearly all the feudal exactions that maddened a whole people to mutiny in 1789 were then in force in England. How shadowy they must have grown is shown by the

* In its primary American sense the word *squatter* denotes the backwoodsman described in the foregoing paragraph. In its secondary Australian sense it means the large landholder now described.

† See an instructive article by Mr. Edward Eggleston, Social Conditions in the Colonies. Century Magazine, 1884, pp. 849, 850.

fact that none of them was transported to Botany Bay in that or later years. They were atrophied portions of the British land system when Australia was founded in 1788. For fully sixteen years the possession of lands granted or seized was as absolute as the English law ever allows it to be. Then the landholders, finding the large tracts already conceded insufficient for the development of the pastoral industry, applied for more, and themselves suggested in 1803 a plan of leasing crown lands which in the following year was legalized as "the first charter of squatterdom"; it was the beginning of a system that has brought under pastoral occupancy territories as extensive as the largest European countries. The land system formed part of or gave birth to a political organization. A host of so-called *seigneurs* imported into old Canada as much of the *ancien régime* as would bear the voyage. Manors in Maryland reproduced the feudal courts-baron and courts-leet. The great New York landowners, as inheriting both English and Dutch institutions, presided in such courts and were at the same time hereditary members of a powerful legislative order.* The courts were dropped on the way out to Australia, but the political influence of the English landed aristocracy inhered in their representatives at the antipodes. As the Southern slavearchy, through its Washingtons and Jeffersons, Clays and Calhouns, was for three quarters of a century the driving force in American politics, the Australian squatterarchy for one generation or more ruled the seven colonies with a sway that waxed as the absolute power of the governor waned. It composed the legislature, appointed the judges, controlled the executive, and if the governor was refractory it sent him home. In both southern countries social life reflected its tastes and was the measure of its grandeur. It constituted "society," ran the races, gave the balls, and kept open house; the surrounding villages lived in its sunshine. Why could not this patriarchal state last, as it has lasted in Arabia for thousands of years and in Europe for centuries? In the Southern States it was brought to bankruptcy by the civil war. In Australia it collapsed before two enemies as deadly—a succession of droughts and a fall in the price of wool. The banker has his foot on the squatter's neck. If one may judge from the published maps, three fourths of the freehold land in the older colonies is in the hands of the money lenders. The once lordly runholder, who would have excluded from his table, or at least from his visiting circle, any one engaged in commerce, is now the tenant of a mortgage company which began by using him too well and ended by crushing him unmercifully.

It is also brought to a close by the rise of the agricultural stage.

* Eggleston, *op. cit.*, p. 850.

The colonial *latifundia* gets broken up for the same economic reasons as that of the mother country. Whenever from the increase of population wheat-growing becomes more profitable than grazing, land rises in value, and vast sheep walks are subdivided into two-hundred-acre farms, which are put under the plow. The transition may be retarded in some countries and altogether arrested in others. Nasse has shown that, in consequence of the moisture of the climate, there was in the sixteenth century a continual tendency in England to revert from agriculture to pasture. The light rainfall, high temperatures, and unfertilized soil will forever keep nine tenths of Australia under grass. Most of the mountainous north and the glacier-shaved portions of the south of New Zealand must be perpetual cattle runs and sheep walks. A century or perhaps centuries will pass before much of the light soil of Tasmania, hardly enriched by the scanty foliage of the eucalyptus, is sufficiently fertilized by grazing to grow corn. Rich alluvial or volcanic lands are put under the plow, without passing through the pastoral stage, as soon as markets are created by the advent of immigrants. There is a cry for farm lands. Companies that have bought large estates break them up into allotments. When they or other large landholders still resist pressure, the radical colonial legislature accelerates their deliberations by putting on the thumbscrew of a statute which confiscates huge cantles of their land. Or the colonial Government, if socialist-democratic, purchases extensive properties, which it breaks up into farms and communistic village settlements. Over wide tracts the agriculturist, great and small, takes the place of the pastoralist. He holds his lands under a variety of tenures. New South Wales, in its search for an ideal form, has flowered into fifteen varieties. Other colonies are stumbling toward it more or less blindly through a succession of annual statutes. Where land is abundant the tenure will be easy. In North America nominal quitrents were general; the system was long since introduced into South Africa, and it has lately been imported into New Zealand in spite of all previous experience to the effect that such rents can not be collected. Mr. Eggleston remarks that in the United States the tendency was to "a simple and direct ownership of the soil by the occupant." Since those days Henry George has come and (alas!) gone. A craze for the nationalization of the land buzzes in the bonnets of all who have no land. There is an equal reluctance on the part of colonial legislatures to grant waste lands as freeholds and on the part of purchasers to accept them on any other terms. Hence the constant effort to devise a tenure which shall reserve the rights of the colony and yet not oppress the tenant. One legislature has blasphemed into the "eternal lease," which would seem to be almost preferable to absolute ownership in a country subject to earthquakes! But the tenure in the early days is unimportant. With a virgin soil yielding at first seventy and then regularly forty bushels to the acre, and high prices ruling, the farmer can stand any tenure. Seen at market or cattle show, his equine or bovine features and firm footing on mother earth suggest a sense of solidity in the commonwealth to which he belongs. He gives it its character. The legislature consists of his representatives. Laws are passed in his interest. He controls the executive. His sons fill the civil service. Judges sometimes come from his ranks, and lawyers easily fall back into them. He supports the churches and fills them. Small towns spring up in place of the pastoral villages to supply his wants. As the period of the Golden Fleece was the colonial age of gold, when Jason, the wool king, made a fortune, received a baronetcy, and, returning to the mother country, founded a county family and intermarried with the British aristocracy, so the agricultural stage is the colonial age of silver, in money as in morals. It lasted in England till well into the century, in Germany till the other day, in France till now. It is, in the main, the stage of contemporary colonies. What brings *it* to an end? The soil gets exhausted, prices fall, and a succession of wet seasons in New Zealand or of dry seasons in Australia or South Africa sends the farmer into the money market. Nearly every province of almost every colony gets mortgaged up to the hilt. The foot of the land agent is on the neck of the farmer, who becomes his tenant or serf—*adscriptus glebæ* as much as the Old English villeins who were the ancestors of the farmer, or the Virginia villeins who repeated in the seventeenth century the Old English status. But tenancy does not always arise out of bankrupt proprietorship. A capitalist may drain an extensive marsh (like that along the valley of the Shoalhaven River in New South Wales) and divide the rich alluvial soil into hundreds of profitable dairy farms. More inland marshes, like the Piako Swamp in New Zealand, have been so completely drained as to make the soil too dry to carry wheat, and so have swamped both capitalists and banker. Where the squatter owner keeps the land in his own hands, he may lease an unbroken-up tract for three or five years to a farmer who plows and fences it, takes off crops, pays a light rent of from five to fifteen bushels per acre, and leaves it in grass. On one tenure or another the whole colony gradually comes into cultivation.

The predominance of the agricultural interest is long threatened and at length shaken by the rise of the industrial stage. It is partly evolved from the pastoral and agricultural stages and partly independent. Nor do these stages at once and necessarily give rise to collective industry. In all young colonies where the population is scanty and processes are simple there are no division and no association of labor. The account that one of the best of American historians gives of the Northwest Territory might be accepted as a description of this primitive state, and realizes Fichte's ideal of a *geschlossener Handelstaat* (closed trade state). Shut in by mountains, the people raised their own flax and sometimes grew their own wool, which they spun and wove at home. They made their own spinning wheels and looms, as they made their own furniture. They tanned their own leather and cobbled rude shoes of it. Of Indian-corn husks they spun ropes and manufactured horse collars and chair bottoms. Barrels and beehives were formed of sawn hollow trees. They extracted sugar from the maple and tea from the sassafras root. Their boats were dug-out canoes. In colonies of later foundation this self-sufficing stage, which repeats an earlier period in the mother country than the time when the colony was given off, is dropped, though there are traces of it everywhere to be found. Sheep countries give birth to the woolen industry. New Zealand reduplicates the woolen manufactures of England and, owing to protective duties, has attained a deserved success. New South Wales, with finer wools, has not succeeded, for no other apparent reason than that she refuses to impose such duties. For it is to be observed that it is under legislative protection—bounties, bonuses, drawbacks, export and especially import duties—that almost every colonial industry has grown up, as the industries of the mother country grew up. Sometimes the profit in a particular undertaking is exactly equal to the amount of the import duty, and it is seldom greater. By taking extravagant advantage of the liberty long refused (as leave to manufacture was long refused to the North American colonies), but at length conceded, to impose import duties, an Australasian colony, misled as much by its own splendid energy as by evil counselors (Carlyle among them), built up a whole artificial system of industries which sank in ruinous collapse when the boom had passed. Independent industries spring first from the soil. Gold and silver mining lose their wild adventurous character, and become regular industries, worked by companies with extensive plants. The digging of gum in Auckland (bled from the gigantic Kauri pine) is operated by merchants who keep the gum diggers in a species of serfage. The discovery of coal makes native industries possible or remunerative, but till iron has been found the system is incomplete. All countries, and therefore all colonies, are late in reaching this stage; the most advanced contemporary colonies have not yet reached it. None the less have they followed England with swifter steps, if with less momentum, into the modern age of iron—that Brummagem epoch which has the creation of markets for its war cry, state socialism for its gospel, Joseph of Birmingham for its prophet, and the British Empire for its deity.

The iron age is fitly inaugurated by the most degraded relationship that man can bear to man—that of slavery. Only the oldest of modern colonies imitate the mother countries in passing through this stage; in those of later foundation a mere shadow of it remains, or it takes other shapes. Colonists first enslave the natives of the country where they settle. In the South American colonies, where they went to find gold, they would work for no other purpose; they therefore needed the natives to till the soil; they needed them also as carriers. For these purposes they were used unscrupulously. They were distributed among the Spaniards under a system of *repartimientos* which repeated the provisions of Greek and Roman slavery, and was itself reduplicated three centuries later in the convict assignment system of New South Wales. With such savage cruelty was it worked that, according to the testimony of Columbus, six sevenths of the population of Hispaniola died under it in a few years. The same form of slavery, but of a very different character, prevailed in Africa down almost to our own times. In the British colonies it was submerged in 1834, from causes exterior to itself, by the humanitarian wave that wrecked the West Indies; in the French colonies it was abolished by the revolutionary government of 1848; in the Dutch colonies it possibly subsists to this day. Theoretically abolished or not, the relationship between civilized whites and savage blacks must be everywhere a modified form of slavery; and a white colonization of the African tropics can only take place under conditions indistinguishable from a limited slavery. In colder or younger colonies, even if a more refined sentiment had permitted it, there could be no question of enslaving the fierce red Indians, the warlike Maoris, or the intractable Australian blacks. The Indians rendered some services to the northern colonists. The Maoris worked for the first immigrants into Canterbury, but as free laborers, and the phase soon passed away as more valuable labor arrived. Blacks were in the early years employed by the Australian settlers, but like nearly all savages they were found incapable of continuous industry. The next step is to import slaves. To lighten the oppression of the Mexicans, negroes were introduced, as they had previously been into Europe. There, and still more in the southern colonies of North America, they were the chief pioneers. They cut down forests, cleared the jungles, drained the swamps, and opened up the country. For the best part of two hundred years the world's sugar, rice, cotton, tobacco, and indigo were grown by negro labor. The effect on the negro himself has been to raise him one grade in the scale of being. If, as Mr. Galton believes, he is naturally two grades below the European, a place in the "organization of labor" will have to be found for him midway between the white workman and the slave. It is, indeed, being found. As a farmer the negro has totally failed. "But he is a good laborer under supervision. He is a success in the mines. He has found acceptance in the iron furnaces and about the coke ovens. He is in great demand in periods of railroad construction," and he is a Western pioneer. Above born and bred slaves for life there is the status of imported slaves for a term. For years Kanakas, hired or captured from the Melanesian Islands of the Pacific, were used as slaves by the sugar planters of Queensland, until the outcry in England put a stop to an ill-conducted traffic. It has since been resumed under humaner conditions, which make it as defensible as slavery can ever be. Coolies from India are imported into Fiji and Hongkong practically as free laborers. They are also employed on board the great liners that ply between India, China, Australia, and England, much to the discontent of the working class and to the great satisfaction of the well-to-do, who thus gain cheaper passages and lower freights. The radical opposition is no more likely to prevent this form of native labor from spreading to all suitable environments than the conservative opposition has prevented women from filling the employments within their improved capacities. The ubiquitous Chinaman, again, has imported himself into most colonies, and so long as he takes a place that the white laborer refuses to occupy, he will present the ugly problem of the coexistence of an indestructible alien race with a civilized people whose type of civilization and his are irreconcilable.

European colonies have also known white slavery, as Greek and Roman colonies knew it, and slavery of their own race and nation, as European countries knew it. Its most degraded type has doubtless been Spanish, English, and French convictism. The Australian-English is the most familiar and the worst. The Australian convict was a slave for life or a long term. Like the slave, he was at the mercy of his master, excepting that corporal punishment could not be inflicted by the master's hands. The lash was none the less kept going; in a single year, in New South Wales, nearly three thousand floggings were administered. The Roman *ergastula* were pleasure bowers compared with the convict hells of Parramatta, in New South Wales, and Port Arthur, in Tasmania. Marcus Clarke's terrible fiction proves to be still more terrible fact. Convicts were herded together like pigs; kindness was rare, oppression general, and many fine men died inch by inch. Such was the state of things even after the introduction of the assignment system. According to that system, convicts were assigned as agricultural laborers and shepherds to settlers who cried out for them, as the American planters did for slaves. Craftsmen were allotted to high officials in lieu of salary or to influential persons who hired them to others (herein repeating English serfdom) or permitted them to work for themselves, receiving a portion of their earnings (herein repeating Greek slavery). Mechanics were employed on public works, and hundreds of buildings were erected by convict masons, bricklayers, and carpenters. Day laborers were employed on roads, and hundreds of miles of solid highway are a durable monument to the memory of the convict. They were the true pioneers of the country, braving the dangers of the "bush," resisting the aborigines, clearing and cultivating the land, and developing the resources of the colonies. For themselves they did well and ill. Many reformed, and after manumission, which was at first special and at length general, became respectable citizens, dealers, and traders. Some grew to be prosperous merchants, wealthy squatters, editors, legislators, and all but ministers. Their sons are judges, legislators, solicitors, Government officials, newspaper proprietors. After lasting for sixty years the system of transportation was at length abolished in consequence of the opposition of the working class, who objected to competition, and of the respectable classes generally. The legislative body and the large landowners were rather in favor of its perpetuity, and there are still members of the old "slave-driving party" in Tasmania who regret its discontinuance.

The bond servants, who were common in New England and at first more numerous than slaves in the Southern States, repeated the status of the English serfs. Their origin was various. Crime, debt, sale by parents, voluntary surrender, and kidnapping all contributed their quota. The period of indentured service was at first from seven to ten years, and was ultimately reduced to a fixed term of four years. They were exchanged and sold like any other commodity. Their treatment seems to have been often harsh. Like the Australian convicts, many of them prospered. Leading families in the United States trace their origin to bondmen. Not a few of the Southern overseers, free laborers, and small farmers are believed to be descended from them. The vagabond element in all the States, the "white trash" of the South, and the criminal and pauper inhabitants of certain regions in the North are also affiliated on the more degraded sections of the class.*

The worst of modern inventions, it has been said, is the invention of the workingman. The workingman, however, has a pedigree; he is the son of the bondman or the serf, and the grandson of the slave, who would have been still more discreditable "inventions" if they had not been the outgrowth of their time and place. The servile character of the workman long survived in European countries; it

* Eggleston, *op. cit.*, p. 858.

was not till the beginning of this century that the last trades were emancipated in England. While in North America and New South Wales the transition is plainly traceable, all vestiges of it have disappeared in the younger colonies. In these, almost from the first, the mechanic is master of the situation. The carpenter who can put up a wooden cottage commands regular work and high wages, while the preacher who builds him a house not made with hands is starved. The anomaly is in perfect consistency with the biological analogy; the brain is everywhere of late development. As the colony grows, wages fall, and the position of professional men becomes more tolerable, but, *en revanche*, the workman acquires and at length almost monopolizes political power. The premier and cabinet ministers are sometimes former peddlers, gold diggers, coal miners, shepherds, etc. The legislative bodies consist largely of labor representatives. Laws are passed in the interest of labor. Not content with a share of political power out of all proportion to their numbers or importance, the regimented trades, under the command of unscrupulous leaders, deliver a pitched battle against the employers, with the object of gaining practical possession of the agencies of production and distribution. They are necessarily defeated. The value of labor and the importance of the mechanic decline with the application of machinery to all industrial processes. Accumulated wealth, subsidizing inventions, acquires an increasing ascendency. The industrial system is in no greater danger from the onslaughts of labor than civilized countries from the invasion of barbarians.

Only the beginnings of the commercial epoch, or age of bronze, are to be found in colonies. In production we witness the same supersession of individual enterprise by the limited liability company. This is also the case in distribution, where many obsolete Old World stages are recapitulated. We may still see the long, slow bullock team, the wearied pack horse (the fur trade in Canada was carried on by "brigades of pack horses"), the hawker, purveyor of news and gossip. We easily trace the evolution of the shop: at first a ship, then landed, with everything inside—groceries, meat, bread, fruit, and vegetables, clothes, crockery, ironmongery, stationery, and tobacco; the butcher first hives off, then the baker, the grocer; in course of time reintegration takes place, and shops are to be found in the colonial cities which reduplicate Whiteley's in London, where everything may again be had as in the beginning. The processes of exchange likewise recapitulate the past. Barter is long universal, and is still common in colonial villages. Even then a standard is needed. In the Old English period the "currency" consisted of cattle, named by a facetious writer "the current *kine* of the realm." In Virginia and Maryland tobacco was the circulating medium for a century and a half, supplemented in Maryland with hemp and flax; taxes were paid in tobacco, and rent in kind. In Illinois and Canada, skins and furs, with wampum for small coin; in New England the latter singular currency was used far into the eighteenth century. New South Wales has the demerit of inventing the destructive medium of rum; wages were paid in it or in wheat; meal or spirits were taken at the doors of theaters. Store receipts for produce were given by the Government and passed current, not without depreciation; military officers issued bills for all sums up to one hundred pounds; private individuals, in the lack of specie, gave promissory notes. Fixed prices were long unknown; extortioners in the early days of all the colonies made a profit of a thousand per cent; and in quite recent days usurious attorneys exacted interest at the rate of a hundred per cent.

Colonies sometimes anticipate the development of the mother country. The communistic dreams of the forties in France and England were for a brief while realized in old Virginia, as they are at this hour being realized in the village settlements of South Australia; and the state socialism rendered popular by the German victories of 1870 was perhaps more thoroughly embodied in convict New South Wales than anywhere else outside of Peru under the Incas, as it is now sweeping all of the Australasian colonies onward to an unknown goal.

THE MIND'S EYE.

By JOSEPH JASTROW.

HAMLET.—My father,—Methinks, I see my father.
HORATIO.— O, where, my lord?
HAMLET.—In my mind's eye, Horatio.

IT is a commonplace taught from nursery to university that we see with our eyes, hear with our ears, and feel with the fingers. This is the truth, but not the whole truth. Indispensable as are the sense organs in gaining an acquaintance with the world in which we live, yet they alone do not determine how extensive or how accurate that acquaintance shall be. There is a mind behind the eye and the ear and the finger tips which guides them in gathering information, and gives value and order to the exercise of the senses. This is particularly true of vision, the most intellectual of all the senses, the one in which mere acuteness of the sense organ counts least and the training in observation counts most. The eagle's eye sees farther, but our eyes tell us much more of what is seen.

The eye is often compared to a photographic camera, with its eyelid cap, its iris shutter, its lens, and its sensitive plate—the retina; when properly adjusted for distance and light, the image is formed on the retina as on the glass plate, and the picture is taken. So far the comparison is helpful; but while the camera takes a picture whenever and wherever the plate happens to be exposed, the complete act of seeing requires some co-operation on the part of the mind. The retina may be exposed a thousand times and take but few pictures; or perhaps it is better to say that the pictures may be taken, but remain undeveloped and evanescent. The pictures that are developed are stacked up, like the negatives in the photographer's shop, in the pigeonholes of our mental storerooms—some faded and blurred, some poorly arranged or mislaid, some often referred to and fresh prints made therefrom, and some quite neglected.

In order to see, it is at once necessary that the retina be suitably exposed toward the object to be seen, and that the mind be favorably disposed to the assimilation of the impression. True seeing, observing, is a double process, partly objective or outward—the thing seen and the retina—and partly subjective or inward—the picture mysteriously transferred to the mind's representative, the brain, and there received and affiliated with other images. Illustrations of such seeing "with the mind's eye" are not far to seek. Wherever the beauties and conformations of natural scenery invite the eye of man does he discover familiar forms and faces (Fig. 1); the forces of Nature have rough-hewn the rocks, but the human eye detects and often creates the resemblances. The stranger to whom such curiosities of form are first pointed out often finds it difficult to discover the resemblance, but once seen the face or form obtrudes itself in every view and seems the most conspicuous feature in the outlook. The flickering fire furnishes a fine background for the activity of the mind's eye, and against this it projects the forms and fancies which the leaping flames and the burning embers from time to time suggest. Not all see these fire-pictures readily, for our mental eyes differ more from one another than the physical ones, and perhaps no two persons see the same picture in quite the same way. It is not quite true, however, as many have held, that in waking hours we all have a world in common, but in dreams each has a world of his own, for our waking worlds are made different by the differences in what engages our interest and our attention. It is true that our eyes when open are opened very largely to the same views, but by no one observer are all these views, though visible, really seen.

This characteristic of human vision often serves as a source of amusement. The puzzle picture with its tantalizing face, or animal, or what not, hidden in the trees, or fantastically constructed out of heterogeneous elements that make up the composition, is to many quite irresistible. We turn it about in all directions, wondering where the hidden form can be, scanning every detail of the picture, until suddenly a chance glimpse reveals it, plainly staring us in the

Fig. 1.*—The man's face in the rocks is quite distinct, and is usually readily found when it is known that there is a face somewhere. (For this view from the Dalles of the St. Croix, Minn., I am indebted to the courtesy of Mr. W. H. Dudley, of Madison, Wis.)

face. When several persons are engaged in this occupation, it is amusing to observe how blind each is to what the others see; their physical eyes see alike, but their mental eyes reflect their own individualities.

* In order to obtain the effects described in the various illustrations it is necessary in several cases to regard the figures for a considerable time and with close attention. The reader is requested not to give up in case the first attempt to secure the effect is not successful, but to continue the effort for a reasonable period. Individuals differ considerably in the readiness with which they obtain such effects; in some cases, such devices as holding the diagrams inverted or at an angle or viewing them with the eyes half closed are helpful.

Thousands upon thousands of persons handle our silver dollar, but few happen to observe the lion's head which lies concealed in the representation of the familiar head of Liberty; frequently even a careful examination fails to detect this hidden emblem of British rule; but, as before, when once found, it is quite obvious (Fig. 2). For similar reasons it is a great aid in looking for an object to know what to look for; to be readily found, the object, though lost to sight, should be to memory clear. Searching is a mental process similar to the matching of a piece of fabric in texture or color, when one has forgotten the sample and must rely upon the remembrance of its appearance. If the recollection is clear and distinct, recognition takes place when the judgment decides that what the physical eye sees corresponds to the image in the mind's eye; with an indistinct mental image the

Fig. 2.—In order to see the lion's head, hold the dollar exactly inverted and the head will be discovered facing the left, as above outlined. It is clearer on the dollar itself than in this reproduction.

recognition becomes doubtful or faulty. The novice in the use of the microscope experiences considerable difficulty in observing the appearance which his instructor sees and describes, and this because his conception of the object to be seen is lacking in precision. Hence his training in the use of the microscope is distinctly aided by consulting the illustrations in the text-book, for they enable his mental eye to realize the pictures which it should entertain. He may be altogether too much influenced by the pictures thus suggested to his mental vision, and draw what is really not under his microscope at all; much as the young arithmetician will manage to obtain the answer which the book requires even at the cost of a resort to very unmathematical processes. For training in correct and accurate vision it is necessary to acquire an alert mental eye that observes all that is objectively visible, but does not permit the subjective to add to or modify what is really present.

The importance of the mind's eye in ordinary vision is also well illustrated in cases in which we see or seem to see what is not really

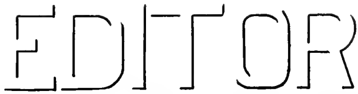


FIG 3.—Observe the appearance of these letters at a distance of eight to twelve feet. An interesting method of testing the activity of the mind's eye with these letters is described in the text.

present, but what for one cause or another it is natural to suppose is present. A very familiar instance of this process is the constant overlooking of misprints—false letters, transposed letters, and missing letters—unless these happen to be particularly striking. We see only

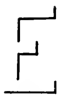


FIG. 3*a*.

FIG. 3*b*.

the general physiognomy of the word and the detailed features are supplied from within; in this case it is the expected that happens. Reading is done largely by the mental eye; and entire words, obviously suggested by the context, are sometimes read in, when they have been accidentally omitted. This is more apt to occur with the

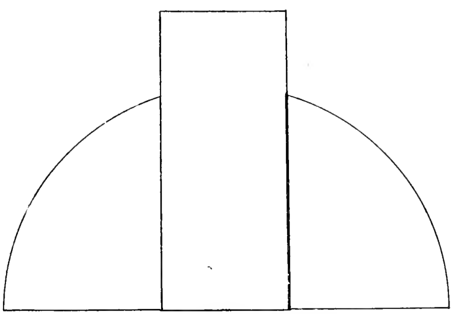


FIG. 4.—For description, see text.

irregular characters used in manuscript than in the more distinct forms of the printed alphabet, and is particularly frequent in reading over what one has himself written. In reading proof, however, we are eager to detect misprints, and this change in attitude helps to make them visible. It is difficult to illustrate this process intentionally, because the knowledge that one's powers of observation are about to be tested places one on one's guard, and thus suppresses the natural activity of the mind's eye and draws unusual attention to objective details. Let the reader at this point hold the page at some distance off—say, eight or twelve feet—and draw an exact reproduction of the letters shown in Fig. 3. Let him not read further until this has been done, and *perhaps* he may find that he has introduced strokes which were not present in the original. If this is not the case, let him try the test upon those who are ignorant of its nature, and he will find that most persons will supply light lines to complete the contours of the letters which in the original are suggested but not really present; the original outline, Fig. 3*a*, becomes something like Fig. 3*b*,

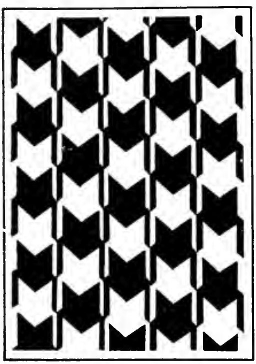


Fig. 5.—The black and white portions of this design are precisely alike, but the effect of looking at the figure as a pattern in black upon a white background, or as a pattern in white upon a black background, is quite different, although the difference is not easily described.

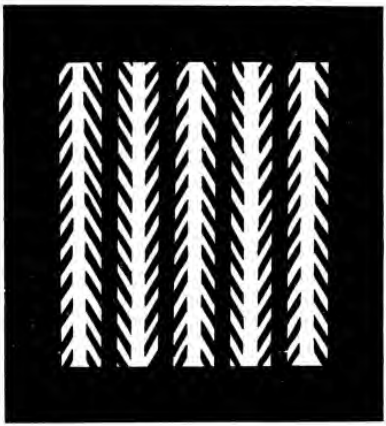


Fig. 6.—When this figure is viewed as a black pattern on a white background, the four main vertical lines seem far from parallel; when it is viewed as a white pattern on a black background this illusion disappears (or nearly so), and the black lines as well as the white ones seem parallel.

and so on for the rest of the letters. The physical eye sees the former, but the mental eye sees the latter.

I tried this experiment with a class of over thirty university students of Psychology, and, although they were disposed to be quite critical and suspected some kind of an illusion, only three or four drew the letters correctly; all the rest filled in the imaginary light contours; some even drew them as heavily as the real strokes. I followed this by an experiment of a similar character. I placed upon a table a figure (Fig. 4) made of light cardboard, fastened to blocks of wood at the base so that the pieces would easily stand upright. The middle piece, which is rectangular and high, was placed a little in front of the rest of the figure. The students were asked to de-

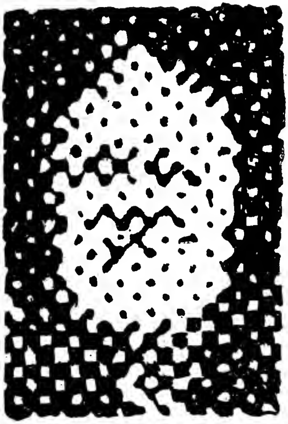


Fig. 7.—This is a highly enlarged reproduction taken from a half-tone process print of Lord Kelvin. It appeared in the Photographic Times.

scribe precisely what they saw, and with one exception they all described, in different words, a semicircular piece of cardboard with a rectangular piece in front of it. In reality there was no half-circle of cardboard, but only parts of two quarter-circles. The students, of course, were well aware that their physical eyes could not see what was behind the middle cardboard, but they inferred that the two side pieces were parts of one continuous semicircle. This they saw, so far as they saw it at all, with their mind's eye.

There is a further interesting class of illustrations in which a single outward impression changes its character according as it is viewed as representing one thing or another. In a general way we see the same thing all the time, and the image on the retina does not change. But as we shift the attention from one portion of the view to another, or as we view it with a different mental conception of what the figure represents, it assumes a different aspect, and to our mental eye becomes quite a different thing. A slight but interesting change takes place if we view Fig. 5 first with the conception that the black is the pattern to be seen and the white the background, and again try to see the white as the pattern against a black background. I give a further illustration of such a change in Fig. 6. In our first and natural view of this we focus the attention upon the black lines and observe the familiar illusion, that the four vertical lines seem far from parallel. That they are parallel can be verified by measurement, or by covering up all of the diagram except the four main

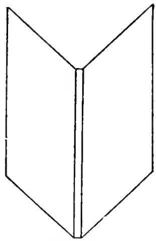


FIG. 8.—This drawing may be viewed as the representation of a book standing on its half-opened covers as seen from the back of the book; or as the inside view of an open book showing the pages.

FIG. 9.—When th's figure is viewed as an arrow, the upper or feathered end seems flat; when the rest of the arrow is covered, the feathered end may be made to project or recede like the book cover in Fig. 8.

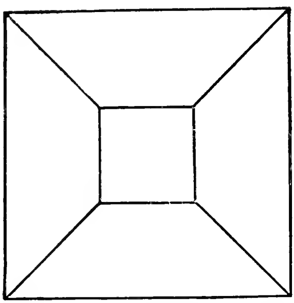


FIG. 10.—The smaller square may be regarded as either the nearer face of a projecting figure or as the more distant face of a hollow figure.

lines. But if the white part of the diagram is conceived as the design against a black background, then the design is no longer the same, and with this change the illusion disappears, and the four lines seem parallel, as they really are. It may require a little effort to bring about this change, but it is very marked when once realized.

A curious optical effect which in part illustrates the change in appearance under different aspects is reproduced in Fig. 7. In this case the enchantment of distance is necessary to produce the transformation. Viewed at the usual reading distance, we see nothing but an irregular and meaningless assemblage of black and white blotches. At a distance of fifteen to eighteen feet, however, a man's head appears quite clearly. Also observe that after the head has once been realized it becomes possible to obtain suggestions of it at nearer distances.

A much larger class of ambiguous diagrams consists of those which represent by simple outlines familiar geometrical forms or objects. We cultivate such a use of our eyes, as indeed of all our faculties, as will on the whole lead to the most profitable results. As a rule, the particular impression is not so important as what it represents. Sense impressions are simply the symbols or signs of things

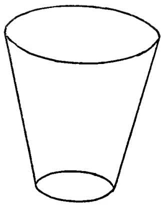


Fig. 11.—This represents an ordinary table-glass, the bottom of the glass and the entire rear side, except the upper portion, being seen through the transparent nearer side, and the rear apparently projecting above the front. But it fluctuates in appearance between this and a view of the glass in which the bottom is seen directly, partly from underneath, the *whole* of the rear side is seen through the transparent front, and the front projects above the back.

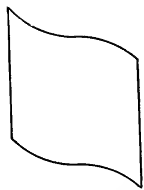


Fig. 12.—In this scroll the left half may at first seem concave and the right convex, it then seems to roll or advance like a wave, and the left seems convex and the right concave, as though the trough of the wave had become the crest, and *vice versa*.

or ideas, and the thing or the idea is more important than the sign. Accordingly, we are accustomed to interpret lines, whenever we can, as the representations of objects. We are well aware that the canvas or the etching or the photograph before us is a flat surface in two dimensions, but we see the picture as the representation of solid objects in three dimensions. This is the illusion of pictorial art. So strong is this tendency to view lines as the symbols of things that if there is the slightest chance of so viewing them, we invariably do so; for we have a great deal of experience with things that present their contours as lines, and very little with mere lines or surfaces. If we view outlines only, without shading or perspective or anything to definitely suggest what is foreground and what background, it becomes possible for the mind to supply these details and see foreground as background, and *vice versa.*

A good example to begin with is Fig. 8. These outlines will probably suggest at first view a book, or better a book cover, seen with its back toward you and its sides sloping away from you; but

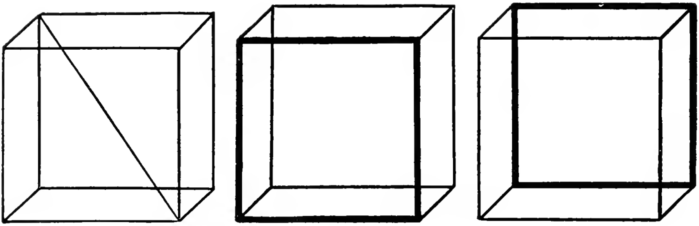


Fig. 13. Fig. 13*a*. Fig. 13*b*.

Figs. 13, 13*a*, and 13*b*.—The two methods of viewing Fig. 13 are described in the text. Figs. 13*a* and 13*b* are added to make clearer the two methods of viewing Fig. 13. The heavier lines seem to represent the nearer surface. Fig. 13*a* more naturally suggests the nearer surface of the box in a position downward and to the left, and Fig. 13*b* makes the nearer side seem to be upward and to the right. But in spite of the heavier outlines of the one surface, it may be made to shift positions from foreground to background, although not so readily as in Fig. 13.

it may also be viewed as a book opened out toward you and presenting to you an inside view of its contents. Should the change not come readily, it may be facilitated by thinking persistently of the appearance of an open book in this position. The upper portion of Fig. 9 is practically the same as Fig. 8, and if the rest of the figure be covered up, it will change as did the book cover; when, however, the whole figure is viewed as an arrow, a new conception enters, and the apparently solid book cover becomes the *flat* feathered part of the

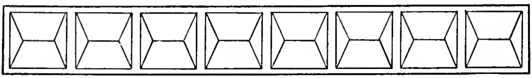


Fig. 14.—Each member of this frieze represents a relief ornament, applied upon the background, which in cross-section would be an isosceles triangle with a large obtuse angle, or a space of similar shape hollowed out of the solid wood or stone. In running the eye along the pattern, it is interesting to observe how variously the patterns fluctuate from one of these aspects to the other.

arrow. Look at the next figure (Fig. 10), which represents in outline a truncated pyramid with a square base. Is the smaller square nearer to you, and are the sides of the pyramid sloping away from you toward the larger square in the rear? Or are you looking into the hollow of a truncated pyramid with the smaller square in the background? Or is it now one and now the other, according as you decide to see it? Here (Fig. 13) is a skeleton box which you may conceive as made of wires outlining the sides. Now the front, or side nearest to me, seems directed downward and to the left; again, it has shifted its position and is no longer the front, and the side which appears to be the front seems directed upward and to the right. The presence of the diagonal line makes the change more striking: in one position it runs from the left-hand *rear* upper corner to the right-hand *front* lower corner; while in the other it connects the left-hand *front* upper corner with the right-hand *rear* lower corner.

Fig. 15 will probably seem at first glimpse to be the view of a flight of steps which one is about to ascend from right to left. Im-

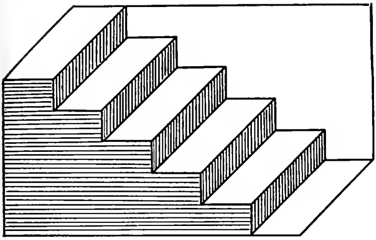


Fig. 15*a*.

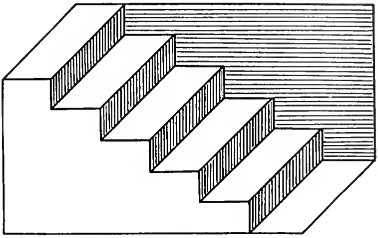


Fig. 15*b*.

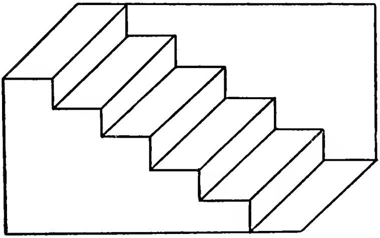


Fig. 15.

FIGS. 15, 15*a*, and 15*b*.—The two views of Fig. 15 described in the text are brought out more clearly in Figs. 15*a* and 15*b*. The shaded portion tends to be regarded as the nearer face. Fig. 15*a* is more apt to suggest the steps seen as we ascend them. Fig. 15*b* seems to represent the hollowed-out structure underneath the steps. But even with the shading the dual interpretation is possible, although less obvious.

agine it, however, to be a view of the under side of a series of steps; the view representing the structure of overhanging solid masonwork seen from underneath. At first it may be difficult to see it thus, because the view of steps which we are about to mount is a more natural and frequent experience than the other; but by staring at it with the intention of seeing it differently the transition will come, and often quite unexpectedly.

The blocks in Fig. 16 are subject to a marked fluctuation. Now the black surfaces represent the bottoms of the blocks, all pointing downward and to the left, and now the black surfaces have changed and have become the tops pointing upward and to the right. For some the changes come at will; for others they seem to come unexpectedly, but all are aided by anticipating mentally the nature of the transformation. The effect here is quite striking, the blocks seeming almost animated and moving through space. In Fig. 17 a similar arrangement serves to create an illusion as to the real number of blocks present. If viewed in one way—the black surface forming the tops of the blocks—there seem to be six arranged as in Fig. 18; but

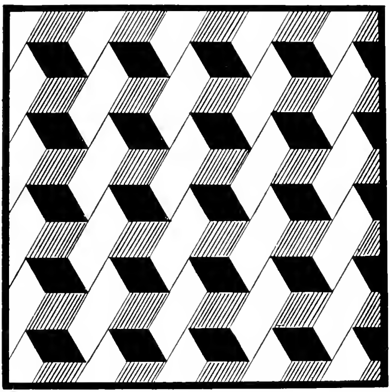


FIG. 16.—This interesting figure (which is reproduced with modifications from Scripture—The New Psychology) is subject in a striking way to interchanges between foreground and background. Most persons find it difficult to maintain for any considerable time either aspect of the blocks (these aspects are described in the text); some can change them at will, others must accept the changes as they happen to come.

when the transformation has taken place and the black surfaces have become the overhanging bottoms of the boxes, there are seven, arranged as in Fig. 19. Somewhat different, but still belonging to the group of ambiguous figures, is the ingenious conceit of the duck-rabbit shown in Fig. 20. When it is a rabbit, the face looks to the right and a pair of ears are conspicuous behind; when it is a duck, the face looks to the left and the ears have been changed into the bill. Most observers find it difficult to hold either interpretation steadily, the fluctuations being frequent, and coming as a surprise.

All these diagrams serve to illustrate the principle that when the objective features are ambiguous we see one thing or another according to the impression that is in the mind's eye; what the objective factors lack in definiteness the subjective ones supply, while familiarity, prepossession, as well as other circumstances influence the result. These illustrations show conclusively that seeing is not wholly an objective matter depending upon what there is to be seen, but is very considerably a subjective matter depending upon the eye that sees. To the same observer a given arrangement of lines now appears as the representation of one object and now of another; and

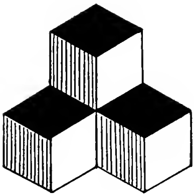


Fig. 17*a*.

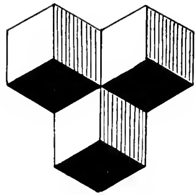


Fig. 17*b*.

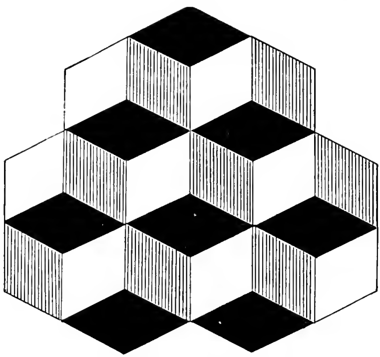


Fig. 17.

FIGS. 17, 17*a*, and 17*b*.—How many blocks are there in this pile? Six or seven? Note the change in arrangement of the blocks as they change in number from six to seven. This change is illustrated in the text. Figs. 17*a* and 17*b* show the two phases of a group of any three of the blocks. The arrangement of a pyramid of six blocks seems the more stable and is usually first suggested; but hold the page inverted, and you will probably see the alternate arrangement (with, however, the black surfaces still forming the tops). And once knowing what to look for, you will very likely be able to see either arrangement, whether the diagram be held inverted or not. This method of viewing the figures upside down and in other positions is also suggested to bring out the changes indicated in Figs. 13, 13*a*, 13*b*, and in Figs. 15, 15*a*, 15*b*.

from the same objective experience, especially in instances that demand a somewhat complicated exercise of the senses, different observers derive very different impressions.

Not only when the sense-impressions are ambiguous or defective, but when they are vague—when the light is dim or the forms obscure

—does the mind's eye eke out the imperfections of physical vision. The vague conformations of drapery and make-up that are identified and recognized in spiritualistic *séances* illustrate extreme in-

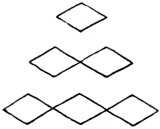


FIG. 18.

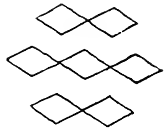


FIG. 19.

stances of this process. The whitewashed tree or post that momentarily startles us in a dark country lane takes on the guise that expectancy gives it. The mental predisposition here becomes the dominant factor, and the timid see as ghosts what their more sturdy companions recognize as whitewashed posts. Such experiences we ascribe to the action of suggestion and the imagination—the cloud "that's almost in shape like a camel," or "like a weasel," or "like a whale." But throughout our visual experiences there runs this

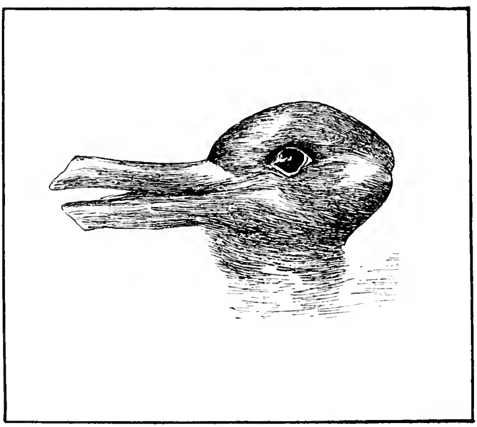


FIG. 20.—Do you see a duck or a rabbit, or either? (From Harper's Weekly, originally in Fliegende Blätter.)

double strain, now mainly outward and now mainly inward, from the simplest excitements of the retina up to the realms where fancy soars freed from the confines of sense, and the objective finds its occupation gone.

NATURE STUDY IN THE PHILADELPHIA NORMAL SCHOOL.

By L. L. W. WILSON, Ph. D.

WHEN it was first proposed to me to write for the Popular Science Monthly a brief account of the biological laboratories in the Philadelphia Normal School, and of the Nature work carried on under my direction in the School of Observation and Practice, I felt that I could not do justice either to the place or the work; for, in my judgment, the equipment of the laboratories and the work done in connection with them are finer than anything else of the kind either in this country or abroad—a statement which it seemed to me that I could not make with becoming modesty. But, after all, it is not great Babylon that I have built, but a Babylon builded for me, and to fail to express my sense of its worth is to fail to do justice to Dr. W. P. Wilson, formerly of the University of Pennsylvania, to whom their inception was due; to Mr. Simon Gratz, president of the Board of Education, who from the beginning appreciated their value, and without whose aid they never would have taken visible form; to the principals of the two schools, and, above all, to my five assistants, whose knowledge, zeal, and hard work have contributed more than anything else to the rapid building up of the work.

The Laboratories and their Equipment.—The rooms occupied by the botanical and zoölogical departments of the normal school measure each seventy by twenty feet. A small workroom for the teachers cuts off about ten feet of this length from each room. In the middle of the remaining space stands a demonstration table furnished with hot and cold water. Each laboratory is lighted from the side by ten windows. From them extend the tables for the students. These give plenty of drawer space and closets for dissecting and compound microscopes. Those in the zoölogical room are also provided with sinks. Each student is furnished with the two microscopes, stage and eyepiece micrometers, a drawing camera, a set of dissecting instruments, glassware, note-books, text-books, and general literature.

The walls opposite the windows are in both rooms lined with cases, in which there is a fine synoptic series.

In the botanical laboratory this systematic collection begins with models of bacteria and ends with trees. In other cases, placed in the adjoining corridor, are representatives, either in alcohol or by means of models, of most of the orders of flowering plants, as well as a series illustrating the history of the theory of cross-fertilization, and the various devices by which it is accomplished; another, showing the different methods of distribution of seeds and fruits; another, of parasitic plants; and still another showing the various devices by means of which plants catch animals.

As an example of the graphic and thorough way in which these illustrations are worked out, the pines may be cited. There are fossils; fine specimens of pistillate and staminate flowers in alcohol; cones; a drawing of the pollen; large models of the flowers; models of the seeds, showing the embryo and the various stages of germination; cross and longitudinal sections of the wood; drawings showing its microscopic structure; pictures of adult trees; and samples illustrating their economic importance. For the last, the long-leaved pine of the South is used, and samples are exhibited of the turpentine, crude and refined; tar and the oil of tar; resin; the leaves; the same boiled in potash; the same hatcheled into wool; yarn, bagging and rope made from the wool; and its timber split, sawn, and dressed.

The series illustrating the fertilization of flowers begins with a large drawing, adapted by one of the students from Gibson, showing the gradual evolution of the belief in cross-fertilization from 1682, when Nehemiah Grew first declared that seed would not set unless pollen reached the stigma, down to Darwin, who first demonstrated the advantages of cross-fertilization and showed many of the devices of plants by which this is accomplished. The special devices are then illustrated with models and large drawings. First comes the dimorphic primrose; then follows trimorphic *Lythrum*, to the beautiful model of which is appended a copy of the letter in which Darwin wrote to Gray of his discovery:

"But I am almost stark, staring mad over Lythrum. . . . I should rather like seed of Mitchella. But, oh, Lythrum!

"Your utterly mad friend,

"C. Darwin."

Models of the cucumber, showing the process of its formation, and the unisexual flowers complete this series. Supplementing this are models and drawings of a large number of flowers, illustrating special devices by which cross-fertilization is secured, such as the larkspur, butter and eggs, orchids, iris, salvia, several composites, the milkweed, and, most interesting of all, the Dutchman's pipe. This is a flower that entices flies into its curved trumpet and keeps them there until they become covered with the ripe pollen. Then the hairs wither, the tube changes its position, the fly is permitted to leave, carrying the pollen thus acquired to another flower with the same result.

Pictures and small busts of many naturalists adorn both of the rooms. Of these the most notable is an artist proof of Mercier's beautiful etching of Darwin. Every available inch of wall space is thus occupied, or else, in the botanical laboratory, has on it mounted fungi, lichens, seaweeds, leaf cards, pictures of trees, grasses, and other botanical objects.

The windows are beautiful with hanging plants from side brackets meeting the wealth of green on the sill. Here are found in one window ferns, in another the century plant; in others still, specimens of economic plants—cinnamon, olive, banana, camphor. On the tables are magnificent specimens of palms, cycads, dracænas, and aspidistras, and numerous aquaria filled with various water plants. Most of these plants are four years old, and all of them are much handsomer than when they first became the property of the laboratory. How much intelligent and patient care this means only those who have attempted to raise plants in city houses can know.

The zoölogical laboratory is quite as beautiful as the botanical, for it, too, has its plants and pictures. It is perhaps more interesting because of its living elements. Think of a schoolroom in which are represented alive types of animals as various as these: amœba, vorticella, hydra, worms, muscles, snails and slugs of various kinds, crayfish, various insects, including a hive of Italian bees, goldfish, minnows, dace, catfish, sunfish, eels, tadpoles, frogs, newts, salamanders, snakes, alligators, turtles, pigeons, canaries, mice, guinea-pigs, rabbits, squirrels, and a monkey! Imagine these living animals supplemented by models of their related antediluvian forms, or fossils, by carefully labeled dissections, by preparations and pictures illustrating their development and mode of life; imagine in addition to this books, pamphlets, magazines, and teachers further to put you in touch with this wonderful world about us, and you will then have some idea of the environment in which it is the great privilege of our students to live for five hours each week.

In addition to these laboratories there is a lecture room furnished with an electric lantern. Here each week is given a lecture on general topics, such as evolution and its problems, connected with the work of the laboratories.

The Course of Study pursued by the Normal Students.—Botany: In general, the plants and the phenomena of the changing seasons are studied as they occur in Nature. In the fall there are lessons on the composites and other autumn flowers, on fruits, on the ferns, mosses, fungi, and other cryptogams. In the winter months the students grow various seeds at home, carefully drawing and studying every stage in their development. Meanwhile, in the laboratory, they examine microscopically and macroscopically the seeds themselves and the various food supplies stored within. By experimentation they get general ideas of plant physiology, beginning with the absorption of water by seeds, the change of the food supply to soluble sugar, the method of growth, the functions, the histology, and the modifications of stem, root, and leaves. In the spring they study the buds and trees, particularly the conifers, and the different orders of flowering plants.

The particular merit of the work is that it is so planned that each laboratory lesson compels the students to reason. Having once thus obtained their information, they are required to drill themselves out of school hours until the facts become an integral part of their knowledge.

For the study of fruits, for example, they are given large trays, each divided into sixteen compartments, plainly labeled with the name of the seed or fruit within. Then, by means of questions, the students are made to read for themselves the story which each fruit has to tell, to compare it with the others, and to deduce from this comparison certain general laws.

After sufficient laboratory practice of this kind they are required to read parts of Lubbock's Flower, Fruit, and Leaves, Kerner's Natural History of Plants, Wallace's Tropical Nature, and Darwinism, etc.

Finally, they are each given a type-written summary of the work, and after a week's notice are required to pass a written examination.

Zoölogy: The course begins in the fall with a rather thorough study of the insects, partly because they are then so abundant, and partly because a knowledge of them is particularly useful to the grade teacher in the elementary schools.

The locust is studied in detail. Tumblers and aquaria are utilized as vivaria, so that there is abundant opportunity for the individual study of living specimens. Freshly killed material is used for dissection, so that students have no difficulty in making out the internal anatomy, which is further elucidated with large, home-made charts, each of which shows a single system, and serves for a text to teach them the functions of the various organs as worked out by modern physiologists.

They then study, always with abundant material, the other insects belonging to the same group. They are given two such insects, a bug, and two beetles, and required to classify them, giving reasons for so doing. While this work is going on they have visited the beehive in small groups, sometimes seeing the queen and the drone, and always having the opportunity to see the workers pursuing their various occupations, and the eggs, larvæ, and pupæ in their different states of development. Beautiful models of the bees and of the comb, together with dry and alcoholic material, illustrate further this metamorphosis, by contrast making clearer the exactly opposite metamorphosis of the locust.

At least one member of each of the other orders of insects is compared with these two type forms, and, although only important points are considered at all, yet from one to two hours of laboratory work are devoted to each specimen. This leisurely method of work is pursued to give the students the opportunity, at least, to think for themselves. When the subject is finished they are then given a searching test. This is never directly on their required reading, but planned to show to them and to their teachers whether they have really assimilated what they have seen and studied.

After this the myriapods, the earthworm, and peripatus are studied, because of their resemblance to the probable ancestors of insects. In the meantime they have had a dozen or more fully illustrated lectures on evolution, so that at the close of this series of lessons they are expected to have gained a knowledge of the methods of studying insects, whether living or otherwise, a working hypothesis for the interpretation of facts so obtained, and a knowledge of one order, which will serve admirably as a basis for comparison in much of their future work.

They then take up, more briefly, the relatives of the insects, the spiders and crustaceans, following these with the higher invertebrates, reaching the fish in April. This, for obvious reasons, is their last dissection. But with living material, and the beautiful preparations and stuffed specimens with which the laboratory is filled, they get a very general idea of the reptiles, birds, and mammals. This work is of necessity largely done by the students out of school hours. For example, on a stand on one of the tables are placed the various birds in season, with accompanying nests containing the proper quota of eggs. Books and pamphlets relating to the subject are placed near. Each student is given a syllabus which will enable her to study these birds intelligently indoors and out, if she wishes to do so.

In the spring are taken up the orders of animals below the insect, and for the last lesson a general survey of all the types studied gives them the relationships of each to the other.

THE COURSE OF STUDY PURSUED IN THE SCHOOL OF PRACTICE.—In addition to the plants and animals about them, the children study the weather, keeping a daily record of their observations, and summarizing their results at the end of the month. In connection with the weather and plants they study somewhat carefully the soil and, in this connection, the common rocks and minerals of Philadelphia—

gneiss, mica schist, granite, sandstone, limestones, quartz, mica, and feldspar.

As in the laboratories, so here the effort is made to teach the children to reason, to read the story told by the individual plant, or animal, or stone, or wind, or cloud. A special effort is made to teach them to interpret everyday Nature as it lies around them. For this reason frequent short excursions into the city streets are made. Those who smile and think that there is not much of Nature to be found in a city street are those who have never looked for it. Enough material for study has been gathered in these excursions to make them a feature of this work, even more than the longer ones which they take twice a year into the country.

Last year I made not less than eighty such short excursions, each time with classes of about thirty-five. They were children of from seven to fourteen years of age. Without their hats, taking with them note-books, pencils, and knives, they passed with me to the street. The passers-by stopped to gaze at us, some with expressions of amusement, others of astonishment; approval sometimes, quite frequently the reverse. But I never once saw on the part of the children a consciousness of the mild sensation that they were creating. They went for a definite purpose, which was always accomplished.

The children of the first and second years study nearly the same objects. Those of the third and fourth years review this general work, studying more thoroughly some one type. When they enter the fifth year, they have considerable causal knowledge of the familiar plants and animals, of the stones, and of the weather. But, what is more precious to them, they are sufficiently trained to be able to look at new objects with a truly "seeing eye."

The course of study now requires general ideas of physiology, and, in consequences, the greater portion of their time for science is devoted to this subject. I am glad to be able to say, however, that it is not "School Physiology" which they study, but the guinea-pig and The Wandering Jew!

In other words, I let them find out for themselves how and what the guinea-pig eats; how and what he expires and inspires; how and why he moves. Along with this they study also plant respiration, transpiration, assimilation, and reproduction, comparing these processes with those of animals, including themselves.

The children's interest is aroused and their observation stimulated by the constant presence in the room with them of a mother guinea-pig and her child. Nevertheless, I have not hesitated to call in outside materials to help them to understand the work. A series of lessons on the lime carbonates, therefore, preceded the lessons on respiration; an elephant's tooth, which I happened to have, helped to explain the guinea-pig's molars; and a microscope and a frog's leg made real to them the circulation of the blood.

In spite of the time required for the physiology, the fifth-year children have about thirty lessons on minerals; the sixth-year, the same number on plants; and the seventh-year, on animals; and it would be difficult to decide which of these subjects rouses their greatest enthusiasm.

PRINCIPLES OF TAXATION.*

By the Late Hon. DAVID A. WELLS.

XX.—THE LAW OF THE DIFFUSION OF TAXES.

PART I.

NO attempt ought to be made to construct or formulate an economically correct, equitable, and efficient system of taxation which does not give full consideration to the method or extent to which taxes diffuse themselves after their first incidence. On this subject there is a great difference of opinion, which has occasioned, for more than a century, a vast and never-ending discussion on the part of economic writers. All of this, however, has resulted in no generally accepted practical conclusions; has been truthfully characterized by a leading French economist (M. Parieu) as marked in no small part by the "simplicity of ignorance," and from a somewhat complete review (recently published †) of the conflicting theories advanced by participants one rises with a feeling of weariness and disgust.

The majority of economists, legislators, and the public generally incline to the opinion that taxes mainly rest where they are laid, and are not shifted or diffused to an extent that requires any recognition

* It is fortunate that Mr. Wells had practically completed his essays on taxation before death put an end to his activity. The manuscript of two chapters was found among his papers—one on the Best Methods of Taxation, and the other on the Law of the Diffusion of Taxes, begun in this number. The first manuscript has some pages missing, and it has been thought best to postpone its publication, in the hope that the missing pages may be found. It is evident that the last touches were yet to be put upon the chapter on the diffusion of taxes—a chapter that was to sum up the theory of taxation developed by the writer. So much of that summary is contained in it as to make the meaning of Mr. Wells unmistakable, and its publication is further amply justified by the number of practical illustrations and happy application of theory to fact, in the selection and explanation of which the author excelled. The entire series, which has been running in the Popular Science Monthly for more than three years, will now be collected in a volume—a worthy memorial to one whose powers of popular exposition of abstract problems placed him among the first of economists in the United States.

† On the Shifting and Incidence of Taxation, by Prof. Edwin R. Seligman, 1892.

in the enactment of statutes for their assessment. Thus, a tax commission of Massachusetts, as the result of their investigations, arrived at the conclusion that "the tendency of taxes is that they must be paid by the actual persons on whom they are levied." But a little thought must, however, make clear that unless the advancement of taxes and their final and actual payment are one and the same thing, the Massachusetts statement is simply an evasion of the main question at issue, and that its authors had no intelligent conception of it. A better proposition, and one that may even be regarded as an economic axiom, is that, regarding taxation as a synonym for a force, as it really is, it follows the natural and invariable law of all forces, and distributes itself in the line of least resistance. It is also valuable as indicating the line of inquiry most likely to lead to exact and practical conclusions. But beyond this it lacks value, inasmuch as it fails to embody any suggestions as to the best method of making the involved principle a basis for any general system for correct taxation; inasmuch as "the line of least resistance" is not a positive factor, and may be and often is so arranged as to make levies on the part of the State under the name of taxation subservient to private rather than public interests. Under such circumstances the question naturally arises, What is the best method for determining, at least, the approximative truth in respect to this vexed subject? A manifestly correct answer would be: *first*, to avoid at the outset all theoretic assumptions as a basis for reasoning; *second*, to obtain and marshal all the facts and conditions incident to the inquiry or deducible from experience; *third*, recognize the interdependence of all such facts and conclusions; *fourth*, be practical in the highest degree in accepting things as they are, and dealing with them as they are found; and on such a basis attention is next asked to the following line of investigations.

It is essential at the outset to correct reasoning that the distinction between *taxation* and *spoliation* be kept clearly in view. That only is entitled to be called a tax law which levies uniformly upon all the subjects of taxation; which does not of itself exempt any part of the property of *the same* class which is selected to bear the primary burden of taxation, or by its imperfections to any extent permits such exemptions. All levies or assessments made by the State on the persons, property, or business of its citizens that do not conform to such conditions are spoliations, concerning which nothing but irregularity can be predicated; nothing positive concerning their diffusion can be asserted; and the most complete collection of experiences in respect to them can not be properly dignified as "a science." And it may be properly claimed that from a nonrecognition or lack of appreciation of the broad distinction between taxation and spoliation, the disagreement among economists respecting the diffusion of taxes has mainly originated.

With this premise, let us next consider what facts and experiences are pertinent to this subject, and available to assist in reaching sound conclusions; proceeding very carefully and cautiously in so doing, inasmuch as territory is to be entered upon that has not been generally or thoroughly explored.

The facts and experiences of first importance in such inquiry are that the examination of the tax rolls in any State, city, or municipality of the United States will show that surprisingly small numbers of persons primarily pay or advance any kind of taxes. It is not probable that more than one tenth of the adult population or about one twentieth of the entire population of the United States ever come in contact officially with a tax assessor or tax collector. It is also estimated that less than two per cent of the total population of the United States advance the entire customs and internal revenue of the Federal Government.

In the investigations made in 1871, by a commission created by the Legislature of the State of New York to revise its laws relative to the assessment and collection of taxes, it was found that in the city of New York, out of a population of over one million in the above year, only 8,920 names, or less than one per cent of this great multitude of people, had "any household furniture, money, goods, chattels, debts due from solvent debtors, whether on account of contract, note, bond, or mortgage, or any public stocks, or stocks in moneyed corporations, or in general any personal property of which the assessors could take cognizance for taxation"; and further, that not over *four* per cent, or, say, forty thousand persons out of the million, were subject to any primary tax in respect to the ownership of any property whatever, real or personal; while only a few years subsequent, or in 1875, the regular tax commissioners of New York estimated that of the property defined and described by the laws of the State as personal property, an amount approximating two thousand million dollars in value was held in New York city alone. Later investigations show that this state of things has continued. Thus, in 1895, out of a population of about two million, it was estimated that only seventy-nine thousand, or not over four per cent of the inhabitants of the city, were subject to primary taxation, and that one half the whole amount collected in that year was paid by less than a thousand persons. In the city of Boston, where the tax laws are executed in the most arbitrary manner, the ratio of population directly assessed is somewhat greater, but aside from the poll tax, which is a per capita and not a property tax, only 7.27 per cent of residents paid a property tax in 1895 out of a population of 494,205. In one of the smaller cities of Massachusetts, where persons and property are capable of more thorough supervision than larger numbers and areas—namely, the city of Springfield, with a population of about fifty thousand—the report of its tax officials shows that for the year 1894–'95 the number of persons and corporations assessed on property (mainly real estate) was 7,745, or one for every 6.4 of its citizens, while 10,560 other citizens were assessed for a poll tax of two dollars only. Of the total amount of taxes assessed—namely, $735,948—the above number, 10,560, paid only $21,120; and this is the experience generally throughout the United States, as it will be in every country under a free popular government, where arbitrary inquisitions and arrests of persons and seizures of property are not allowed, and where a soldier does not practically stand behind every tax assessor and collector.

The time (1871) when the personal investigations above referred to were made was when the masses of the city of New York were moved with indignation at the misuse and private appropriation by a few officials (Tweed and his associates) of the municipal revenues raised by taxation, under cover of instituting public improvements, and which finally led to their prosecution, imprisonment, or self-imposed exile; and the questions which naturally suggested themselves were: If only some forty thousand of the million in New York city paid the taxes, what interest had the other nine hundred and sixty thousand who never saw the face of a tax assessor or collector in opposing corruption? What, in an honest administration of the city government and in a reduction of taxes? Must it not be for the interest of the many that the expenditures of the State shall always be as large as possible? Must they not be benefited by exorbitant taxes on the owners of property, and a distribution of the money collected, even if stolen by corruptionists, but spent by them lavishly on enterprises that will furnish new opportunities for employment or amusement for the masses? Clearly, so far as any personal experience growing out of any *direct* assessment and levy was concerned, ninety-six per cent of the population of the city had no more cause of personal grievance by reason of the unlawful taking of money from the city treasury than they would have had at the taking of an equivalent amount from the municipal treasuries of London, Paris, or any other city.

The answer to these questions is to be found in the fact, as John Adams once remarked, that "if the Creator had given man a reason that is fallible, he has also impressed upon him an instinct that is sure." And this instinct teaches the masses everywhere, though they have never read a book on political economy, or heard any one discourse learnedly on the principles of taxation, that if taxes are increased, either by a lawful or unlawful expenditure of public money, they can not in any possible way avoid paying some portion of its increase; or, in other words, that increased taxes meant increased cost of living, through increased rents, increased price of fuel, clothing, and provisions, and possibly diminished opportunity to labor through such increased cost of the products of labor as would limit and restrict markets or consumption. In short, that taxes inevitably fall upon them through the increased price of all they consume, even if they pay nothing to the tax collector directly. A large proportion of the masses of the city of New York in 1871–'72, who paid no taxes directly, accordingly and spontaneously joined hands with the comparatively few of their fellow-citizens who did pay in resisting extravagance and corruption.*

We are thus led up and forced to the recognition of two propositions, or rather principles, in respect to taxation that can not be invalidated. The *first* is, that it is not necessary that a tax assessor or collector should personally assess and levy upon every citizen of a State or community in order that all should be compelled to contribute of his property for the support of such State or community; *second*, that there is an inexorable law by which every man must bear a portion of the burden of public expendiures, even though the official assessors take no direct cognizance of him whatever.

The following incident may here be cited as instructive: In one of the recent official hearings before a legislative committee of one of the States, a strenuous advocate of the popular doctrine that there was and could be no such thing as equality in taxation except by rigidly taxing everybody directly for all his property, of every description, both real and personal, and that to not tax immediately and directly was, in at least a great degree, to exempt from taxation, expressed himself as entirely opposed to any system of restricting assessments to a comparatively few things, on the ground that it would be a recognition in the United States of a system which in Great Britain had ground down the masses into poverty. He, however, obtained some new light on the subject of nondiffusion by being reminded that if the masses of England had been grievously oppressed by taxation, it had been under a system of many years' standing, which never in any way brings the tax collector in direct contact with nineteen twentieths of the entire population; the cus-

* The assertion would not be warranted that the masses of New York were wholly unanimous in condemning Tweed, for a portion of them were undoubtedly well content with the situation. He had curried favor with the very poor and ignorant by distributing coal and flour, and making ostentatious presents of money; and these "charities" are remembered to this day in the poorer parts of New York city, and Tweed is esteemed by many as the victim of injustice, and a man who suffered because he was the friend of the people.

toms taxes of Great Britain being practically levied on only four articles—spirits, tea, coffee, and tobacco; and the inland revenue also on practically four—spirits, beer, legacies and successions, and stamps (on deeds, insurance policies, bills of exchange, receipts, drafts, etc.). Generalizing, then, on the basis of so broad a fact, how illogical and unscientific was the assumption that whatever persons, property, or business are not taxed directly are exempt from taxation!—and yet the practical exemplification of such a system, in the case of England, was a most efficient instrumentality for grinding the masses of her people down to poverty.

On the other hand, to generalize from the experience of an individual or a class in place of that of a nation or community, let us take the case of a person who passes all the year *in transitu*—moving backward and forward, for example, in a boat on the line of the Erie Canal, or between the head waters of the Mississippi and its mouth; a citizen of no one State, a resident in no one town, and buying all that he eats, drinks, and wears wherever he can buy cheapest. Does this man escape taxation because he has no permanent *situs* (residence as a citizen), and is unknown by any assessor? If he does, then his occupation is more profitable to the extent of the taxes he avoids than is that of the individual who, following analogous occupations, resides permanently in one location, and pays taxes regularly; or else some notable, easily discernible cause, as undue competition to obtain situations, will account for his exemption.

Let us next consider how practical experience definitely indicates the line of least resistance, in conformity with which those contributions of property or service which the State requires its citizens to make for its support, and are worthy of designation as taxes, diffuse themselves. Let us take first that form of indirect taxation which is known as customs, or taxes on imports, one from which the Federal Government of the United States has derived in recent years more than half of its revenue, and Great Britain more than one fourth of its total receipts from all forms of imperial taxes. That all such taxes as a rule diffuse themselves, and ultimately fall upon and are paid by final consumers, is capable of demonstration by a great variety of evidence. Every remission of customs duties on the imports into any country of its staple articles of consumption is followed by a reduction of cost approximately equal to such reduction, and a consequent increase in consumption. On the other hand, nothing is better settled than that an increase in customs taxes on imported articles as a rule increases prices and tends to reduce consumption. When Great Britain, in 1863, reduced her taxes (duties) on her imports of tea from 1*s.* 5*d.* to 1*s.* per pound, her importation of tea increased from 114,000,000 pounds in 1862 to 139,000,000 in

1866, and her per capita consumption during the same period from 2.70 pounds to 3.42 pounds; and again, when the duty was further reduced in 1865 from 1*s.* to 6*d.* per pound, the annual importations increased from 139,000,000 in 1866 to 209,000,000 in 1881, and the per capita consumption from 3.42 pounds to 4.58.

When by the act of October, 1890, the tax was removed from the imports of crude sugars into the United States, the price of the same went down almost immediately to an equal extent in all American markets; while the consumption of sugar in the country increased from an average of about fifty-four pounds per capita in 1890 to more than sixty-seven pounds in 1892. A like result has attended a similar experience in respect to this in other countries, and especially in Great Britain. Thus, the aggregate consumption of sugar by the British people in 1844 was returned at 237,143 tons. A reduction of taxes on its importation in 1864 increased its domestic use to 528,919 tons; a reduction of fifty per cent on existing rates in 1870 made it 695,029 tons; another reduction of fifty per cent in 1873 carried up consumption to 779,000 tons; and when, in 1874, all taxes on the imports of sugar were abolished, the annual domestic consumption increased in little more than a year's period to 930,000 tons. On the other hand, when by the tariff act of 1890 an additional tax of half a cent per pound was imposed on the import of tin plate into the United States, tin plate went up to an equal extent in price all over the country; and so also on pearl buttons, linen goods, and other articles of foreign production on the importations of which the tariff taxes were largely increased. By the tariff act of 1890, also, eggs, which could formerly be imported into the United States free of duty, were made subject to a tax of five cents per dozen. Since then the price of eggs imported from Canada into districts of the United States within the same sphere of territorial competition has been increased to the American consumers to almost exactly the extent of the import tax to which they are subjected. Thus, when the price of eggs was ten and a half cents per dozen in Toronto, they were sixteen cents in Buffalo and sixteen and a half to seventeen cents in New York. Such a result would be unaccountable if the Canadian farmers paid the duty on eggs sent by them to the United States.

It is interesting to here ask attention to the opinions entertained and expressed by those whose situation and experience have qualified them to speak with authority: "The duty constitutes the price of the whole mass of the article in the market. It is substantially paid on the article of domestic manufacture, as well as that of foreign production" (John Quincy Adams). "I said it, and I stand by it, that as a general rule the duties paid on imports operate as a tax upon the consumer" (John Sherman). Mr. Blaine, in his Twenty Years in

Congress, says, speaking of the increase of duties on imports by the tariff act of July 14, 1862, that it "shut out still more conclusively all competition from foreign fabrics. The increased cost was charged to the consumer." Mr. McKinley, in 1890, in a report introducing a bill for revision of the tariff of the United States, in the direction of increased rates of duties on imports, said it was not the intent of the bill "to further cut down prices," that the people were "already suffering from low prices," and would not be satisfied "with legislation which will result in lower prices." In an elaborate opinion given by the New York Court of Appeals in 1851 (see vol. iv, New York Reports), in which there was no suspicion of any issue of free trade or protection, the courts, in carefully considering the relative powers of the legislature and the judiciary in respect to taxation, assumed the proposition that "*all duties on imported goods are taxes on the class of consumers*" to be in the nature of a self-evident truth or economic axiom.

Henry Clay, in a celebrated speech in the United States House of Representatives in 1833, in advocacy of a protective tariff policy, candidly admitted that "in general it may be taken as a rule that the duty upon an article forms a portion of its price." But he subsequently qualified such admission by claiming that it does not follow that any consequent enhancement of its price is a tax on consumers, inasmuch as "directly or indirectly, in one form or another, all consumers of protected articles, enhanced in price," will get an equivalent. But this may be equally affirmed of all necessary and equitable taxation, and does not in any way antagonize the theory that the final incidence of the class of taxes under consideration falls on consumption.

But, notwithstanding these conclusions and the incontrovertible evidence by which they are supported, not a few persons occupying places of great legislative influence, and no small part of the general public, hold to the view that taxes on imports are really in the nature of premiums paid by foreigners for the privilege of selling their goods in the markets of the importing country, and do not fall on its people who consume them. That means that if the foreigner has a yard of cloth, or other commodity, which he sells at home for one dollar, and the United States imposes a tariff of fifty cents on it, he will then sell it for export to America at fifty cents. There is no instance mentioned in history where this has ever been done, but history unfortunately is rarely taken into account by the public in the discussion of these questions. In this connection the following historical incident is interesting and instructive: In 1782 an attempt by the Congress of the Confederation of the several American States to provide a system of revenue to defray the general expenses of the

Confederation by duties on imports, which then was not permissible, was blocked by the refusal of the State of Rhode Island to concur in it, the Legislature of that State unanimously rejecting the measure for three reasons—one of which was that it would bear hardest on the few commercial States, particularly Rhode Island, which in virtue of their relations with foreign commerce monopolize imports, and lightest on the agricultural States, that directly imported little or nothing. Congress appointed Alexander Hamilton to draft a reply to Rhode Island, and in his answer he relied mainly on what he regarded as an incontrovertible fact, that duties on imports would not prove a charge on an importing State, but on the final consumers of imports, wherever they may be located.

If the theory and assumption so confidently and generally asserted are to be accepted as correct, that the foreigner pays the protective taxes which a country levies on its imports, and that they do not fall upon or are not paid by its people who consume them, then it must follow that to the extent that a country taxes its imports it lives at the expense of foreign nations; and that, as Great Britain is the country with which the United States has the largest foreign trade, it must pay the largest share of the customs taxes of the United States, or a good share of its annual revenue from all sources. Attention is further asked to the exact practical application of this theory. Thus, the United States in 1895 imported $36,438,196 worth of woolen manufactures, on which it assessed and collected duties (taxes) to the amount of $20,698,264, or 56.80 per cent of the value of such imports. Certainly this was a pretty heavy tax on foreign nations in respect to the sales of only one class of these commodities; but it represented but a tithe of what the tariff taxes of the United States, if paid by foreigners, cost them. Thus they had to sell their woolens to the people of the latter country at less than half their value in order to compensate for the 56.8 per cent tax. But a nation engaged in foreign trade can not as a rule have two prices for the product of its industries; or one price for what it sells at home and another and different price for what it sells to foreigners. So the fifty-six per cent deducted from the cost of the woolens sold by foreigners to the United States necessarily had to be deducted not only from so much of their product consumed at home, but also from what they sent for sale to all foreign countries. A further practical application of this theory is worthy of consideration. As Great Britain imposes no protective duties or taxes on its imports, it evidently can not collect anything from other nations by the system of taxation under consideration. On the other hand, the aggregate value of its exports sent to foreign nations during the year 1892 was $1,135,000,000, and if these several nations taxed this value at the average rate which the United States imposed in 1894 on all its dutiable imports—namely, fifty per cent—Great Britain obviously had to pay some $557,000,000 in that year for the support of foreign governments; and while this has been the experience of Great Britain for more than forty years of this century, she has as a nation been increasing in wealth during this whole period.

Some of the recent official experiences of the Government of the United States that are pertinent to the topic under consideration are sufficiently curious to make them worthy of an economic record. In a speech introducing a bill into the United States House of Representatives, which subsequently resulted in the tariff act of 1890, the then chairman of the Committee of Ways and Means laid down the following proposition: "The Government ought not to buy abroad what it can buy at home. Nor should it be exempted from the laws it imposes upon its citizens."

This would seem to warrant the characterization of a discovery that the United States had some reliable and important source of revenue independent of taxation,* and that, by compelling the application of a part of this income to the payment of taxes to itself, the Government is placed upon an equality with the citizens. A legitimate criticism on this proposition is that the idea that all the income of the Treasury is derived from the people, and that to transfer portions of this income from one official recipient to another can have hardly any other result than an additional cost of bookkeeping, seems never to have entered the mind of the speaker.

Again, the United States tariff act of 1883 contained in its free list a provision for the admittance of "articles imported for the use of the United States, provided that the price of the same did not include the duty" imposed on such importations. Under the tariff act of 1890 this provision was stricken out of the statute, with the result that when the Government imported any articles for its own use which were subject to duties (as, for example, materials to be used in the National Bureau of Printing and Engraving), it was obliged, in virtue of its nonexemption from the laws which it imposed on its own citizens, to pay such duties itself. But as the Government has no authority to expend money for any purpose without the authority of Congress, the latter body accordingly authorized the Federal Treasury to apropriate money from its tax receipts and make payments with the same to the customhouse, which the customhouse was to immediately pay back into the Treasury. Just what process

* Of the net ordinary receipts of the Federal Government ($385,819,000) in 1893, only about $12,000,000 was derived from sources that could not be regarded as taxes, and were mainly receipts from the sales and surveys of public and Indian lands ($4,120,000) and of other Government property.

was gone through with to effect such a result the public was not informed, but probably the collector of customs drew his warrant on the Treasury, had the amount credited to his account, and then re-credited to the Treasury. But, be this as it may, it is clear that the Government, under the conditions above stated, paid the tax on its imports; that the tax may be regarded in the light of a penalty on the Government for importing articles for its own use; and that the action of Congress in authorizing the Treasury to appropriate money for the payment of such taxes was a recognition or admission by that body that a tax upon imports neither puts anything *in* nor takes anything *from* the pocket of the foreigner. Does it not, moreover, invest with a degree of comicality a law enacted by the Congress of the United States for the purpose of taxing foreign importers, which necessitated the enactment by it of another law appropriating money to enable the United States to pay customs taxes every time on everything that it may import for its own use? * Finally, if the foreigner

* In 1897 the merchant tailors of the United States, who ought to know something about the incidence of a custom tax on imported clothing, united in a petition to Congress asking that Americans returning from Europe be permitted to introduce only two suits of foreign-made clothes free of duty; and in support of their request they comment as follows on a ruling of the Treasury in respect to this matter: "Under this ruling it was possible to enter free of duty vast quantities of foreign-made garments which had never been actually in use, and which were so imported solely because there exists a relative difference of at least fifty per cent in values between the cost of made-up garments in the United States and Europe, thus saving to the purchaser of garments abroad one half of their actual value upon arrival within the United States duty free." But if the foreigner who made and sold the goods in question was liable to pay the duty on dutiable clothing, and attended to his duty, there would be no profit to the returning tourist in importing clothing free of duty. It is further evident also that American tailors agree in opinion with Alexander Hamilton that the consumers of imported articles pay the customs taxes.

The records of the commercial relations between the United States and Canada are exceedingly instructive on this matter. They all show that for the products which the Canadian sends to the United States, and on which somebody pays the duty, he receives exactly the same price as for those products which he sends to England, on which nobody pays any duty. This experience is exactly the same as that of the farmers of the Northwestern States of the Federal Union, who usually get the same price for their wheat furnished to a Minnesota flour mill, or for shipment to free-trade England, as to countries like France and Germany, where heavy duties are assessed upon its import. The term "usually" is employed, for producers in the United States and Canada alike do not always get as large a price for the articles they export as for the same articles they sell to their fellow-countrymen. Again, if it be true, as the advocates of extreme protection assert, that the foreign exporter and not the consumer pays the duties on goods sent by him for sale in this country, how does it happen that it is not true concerning the farm produce and live stock exported from Canada? And why should American farmers be exempt from this rule in sending their grain to Europe? Has anybody ever known of England buying American products any cheaper in New York than France or Germany, and is it not also true that the French or German or Italian consumer usually pays at least the amount of the duty levied by his Government more for American products than his English competitor has, whose imports are subjected to no duty? During the period from 1854 to 1866 there was, under the reciand not our citizens pays our customs taxes on imports, what is the object of placing by specific statutes any article on the free list? Why not let him continue to pay millions of taxes for us, as, for example, on sugar?

OUR FLORIDA ALLIGATOR.

By I. W. BLAKE.

An alligator is not an attractive creature. He has not a single virtue that can be named. He is cowardly, treacherous, hideous. He is neither graceful nor even respectable in appearance. He is not even amusing or grotesque in his ungainliness, for as a brute—a brute unqualified—he is always so intensely real, that one shrinks from him with loathing; and a laugh at his expense while in his presence would seem curiously out of place.

His personality, too, is strong. Once catch the steadfast gaze of a free, adult alligator's wicked eyes, with their odd vertical pupils fixed full upon your own, and the significance of the expression "evil eye," and the mysteries of snake-charming, hypnotism, and hoodooism will be readily understood, for his brutish, merciless, unflinching stare is simply blood-chilling.

Zoölogically the alligator belongs to the genus *Crocodilus*, and he has all the hideousness of that family, lacking somewhat its bloodthirstiness, although the American alligator is carnivorous by nature, and occasionally cannibalistic. Strictly speaking, however, the true alligator is much less dangerous than his relatives of the Old World, and he is correspondingly less courageous.

One would suppose the saurians, or crocodilians, from their general appearance to be huge lizards, but the resemblance is superficial. The whole internal structure differs widely, and, subdivided

procity treaty, practically free trade between Canada and the United States in live stock, wool, barley, rye, peas, oats, and other farm products, while subsequent to 1866, when the reciprocity treaty had been repealed, duties were imposed on all these articles on their import from Canada into the United States. During the first period Canadian horses, for example, sold under free trade for shipment to the United States at from sixty-five to eighty-five dollars each, while during the years next subsequent to 1866 the value of the Canadian horses imported into the United States was returned at from ninety-two to one hundred and four dollars each; thus showing that the United States tariff did not force the Canadian horse breeders to lower their prices in order to compensate American purchasers for the duties exacted. And as regards the other products mentioned, the official data show that in no case did the imposition of duties under the United States tariff reduce the prices paid by American purchasers to the Canadian farmers for their products. These are very commonplace, very familiar, and very convincing facts which ought to silence all this talk about the foreign exporter or anybody else but the consumer paying the duty; but it is not at all probable that they will.

into gavials, crocodiles, and alligators, they form a family by themselves which is widespread, extending into considerable areas of the temperate regions.

All crocodilians are great, ungainly reptiles, having broad, depressed bodies, short legs, and long, powerful, and wonderfully flexible tails which are compressed—that is, flattened sideways. Upon the upper surface of the tail lie two jagged or saw-toothed crests, which unite near the middle of the appendage, continuing in a single row to the extremity.

All have thick necks and bodies protected by regular transverse rows of long, horny plates or shields, which are elevated in the center into keel-shaped ridges, forming an armor that is quite bullet-proof. The throat, the under side of the neck, and belly are not thus protected, and it is at these places, as well as at the eyes, and also just behind the ears, that the hunter directs his aim.

The principal points of difference between a gavial and a crocodile are these: the former has very long, slender jaws, set with twenty-seven teeth in each side of the upper jaw and with twenty-five teeth in the under, while at the extremity of the snout there are two holes, through which pass upward the lower large front teeth, but all the remaining teeth are free, and slant well outward; whereas a crocodile has a head that is triangular, the snout being the apex; a narrow muzzle, and canine teeth in the lower jaw, which pass freely upward in the notches in the side of the upper jaw.

An alligator has a broad, flat muzzle, and the canine teeth of the lower jaw fit into sockets in the under surface of the upper jaw. It is strictly an American form of the family. Its feet being much less webbed, its habits are also less perfectly aquatic, and, preferring still or stagnant fresh-water courses or swamps, it is rarely found in tide-water streams.

The crocodile, on the contrary, is commonly found in swift-running, fresh and salt water rivers. He is a sagacious brute, and ferocious, often attacking human beings without provocation; but the alligator, as a rule, is not disposed to fight, although in South America, where it goes by the name of *caiman* or *cayman*, it grows to an enormous size, and is said to be fully as dangerous as the crocodile. There is also a variety of the family—that is, a true crocodile—found in Florida, but it is very rare, and smaller than its Asiatic relative.

The mouths of all these reptiles, which are large and extend beyond the ears, present a formidable array of sharp, conical teeth of different sizes, set far apart in the crocodile and the alligator, some being enlarged into tusks. All are implanted in separate sockets, and form a single row upon each jaw. When a tooth is shed or broken, a new one promptly comes up beneath the hollow base of the old one; and in this way, all ready for the need, sometimes three or four waiting teeth, packed together like a nest of thimbles, may be seen in the jaw of a dead alligator.

The alligator is at best an awkward brute. Slow and ungainly upon land—although even there his powerful tail can, when neces-

Young Pet Alligator. From photograph by E. L. Russell, Palm Beach.

sary, assist the scuffling paws to an astonishing extent if the creature is in haste—he shows to better advantage in the water. There he turns his clumsy body with wonderful dexterity and swiftness, when, at the sight of a swimming muskrat or a wading dog, he instantly changes from what has resembled a drifting log idly floating upon the calm surface of the swamp, into a thing of life—fierce and horrible.

The general food of an alligator is fish, turtles, and frogs, with an occasional heedless dog or fowl. A number of adult alligators will quickly deplenish a small, clear-water lake of its finny inhabitants, which statement to would-be Florida fishermen will readily account for the lack in many localities. There is also a curious belief in the

South that the creature has an especial liking for a "darkey steak," and for this reason he is feared by the negroes. That he becomes carnivorous to a dangerous extent when pressed by hunger, there is no doubt, for, the supply of fish exhausted, he must look for larger game.

Partially concealed by rubbish, or floating idly close to the bank —always only a short distance from his retreat—he so closely resembles an old and weather-worn log that no suspicion is aroused. Presently a razorback comes down the narrow trail that meanders through the scrub and passes close to the reptile. Let it pass between the alligator and the water—that is, between the creature and his *cave*— and the end has come. An alligator seldom misses, and one spring, leap, or plunge, or whatever the swift, clumsy movement may be called, and the wretched animal is seized and held fast, either by the nose or leg, as a rule. Then the struggle begins, for the razorback loves its life, despised pig of the Florida flatwoods though it is.

Alligators drown their prey. Their own nostrils and throats are so arranged that they themselves can sink to the bottom without danger of suffocation, although their mouths, or rather their jaws, may be widely stretched with the body of their victim. Indeed, they can reascend to the surface to breathe without releasing the prize; and, as this power is so closely connected with their method of killing the larger animals, a description of the latter, repulsive though it is, may not be out of place.

The teeth of an alligator are better adapted for crushing and crunching than for biting. Therefore, for him to eat a struggling animal would be difficult. Instinct teaches him that it must first be killed.

To dispose of a dog or a chicken is a small matter, for when the alligator meets it upon the bank one strong, far-reaching sweep of the powerful tail tosses it far out upon the lake. The alligator simply follows, grasps the half-stunned creature in his jaws, and disappears beneath the surface, where he remains until all is quiet. With a larger animal, however, he proceeds differently, for the reason that a yearling, a colt, or a razorback is not so easily handled. First, therefore, a description of an alligator's cave must be given, since it is to this grewsome retreat that the hideous brute takes his booty.

Selecting some spot where the water is deep—usually beneath some overhanging bank—an alligator excavates what is called a "cave." Any one, standing upon the border of a lake or swamp in Florida, may, all unconsciously, be directly over one of these places. He makes it sufficiently large to accommodate one or more of his kind, by dragging out the mud and roots with the strong claws or nails that arm his fore paws or legs. These "caves" serve in winter for hibernation, and at other times for the purpose that will be explained.

Once in the water, then—to return to the unhappy razorback—the alligator does not rely wholly upon his teeth and jaws to hold the desperate animal. He can not yet sink, for the victim is too strong. It must first be drowned, and a furious struggle for the mastery then begins.

By degrees the brute finally succeeds in dragging the animal out into water sufficiently deep to suit his purpose, and then he clasps it firmly with his paws, precisely like the hugging of a bear. He then begins to roll over and over. Now beneath the surface, now out, he turns and turns, first the alligator uppermost, then his prey, alternately, until the poor animal is drowned literally by inches. Before long the razorback weakens, his struggles lessen, and then the alligator sinks to the bottom, and when all motion has ceased he deposits the body in his cave, well pleased with the prospect of a full larder for some time to come.

One might naturally ask just here whether or not this scene would be the same were a human being the victim. The reply would be—precisely.

The alligator undoubtedly prefers his food in a partly decomposed condition, although it is an undecided point whether this preference arises from a natural taste, or for the reason that food in that state is softer and more easily torn apart. Whichever may be the case, Nature unasked supplies the remedy, and the alligator takes advantage of her assistance, and deposits his victim in his hiding place, confident that at the proper time it will rise to the surface in the condition best adapted to his needs.

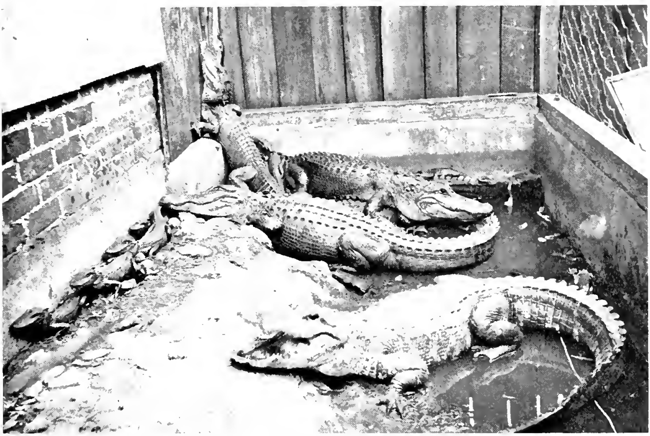
Although by nature the alligator is amphibious, he passes the greater part of his time upon land during the breeding season. At such times, also, he migrates from one clear-water lake or swamp to another, should he not find a mate in his own locality, and he may not infrequently be met in his overland journeyings. Alligators are not strictly gregarious, although large numbers are found in the same body of water; while, on the contrary, there will often be but one or two that will haunt a certain tract for a long period.

During this season the bull alligator is very noisy, and his deep bellowing may be heard for a long distance. To state that this noise causes the ground to vibrate may seem an exaggeration, but the fact may easily be proved by visiting a swamp where the reptiles have congregated. The water in the vicinity will plainly show the jarring of the ground.

This bellow is a thundering, rumbling sound; and when it is combined with the startling hisses, blowings, sighs, and deep-breathed snorts which the creature can produce at will, no one will be likely to dispute that his collection of diabolical noises is quite complete.

During the period of incubation the female alligator is a devoted mother. She does not desert her nest from the time that the eggs are laid until they are hatched—lying concealed in the scrub close by—and she is naturally, at this time, most dangerous to approach, although her vigilance does not always save a portion of her unhatched progeny from the numerous enemies that have a fondness for alligator omelet.

The nest is a large, well-rounded heap or mound, composed of sand and rubbish, which she drags and pushes together with her



Group of Captive Alligators. From photograph by O. P. Hareus, Jacksonville.

claws. Throughout this mound she deposits her eggs, from forty to seventy and over. These eggs resemble those of a goose, only that they are larger; they have a thick, tough shell, and are of about the same size at both ends. In about sixty days, the heat of the sun, combined with the warmth and moisture generated by the fermentation of the rubbish, completes the process of incubation, and the little ones begin to come forth.

Forcing their way through the sand, they hurry down the sloping sides of the mound, straightway seeking the water by instinct. While these baby 'gators are thus kicking and flinging off their shell overcoats as they emerge from their incubator, perfect little duplicates of their mother—only that they are rather pretty in their clean, glossy, black or dark-brown skins, which have orange-colored stripes that completely ring their miniature tails and bodies—she wanders anxiously about, probably wondering how many of her family will succeed in running the very uncertain gantlet of life.

For, eaten while in the egg stage by birds and animals, and swallowed by open-mouthed, expectant fishes, and by other alligators—often led, if the truth must be told, by the interesting father himself—as soon as they reach the water, the early days of an alligator are full of trouble. That enough escape to prevent extinction, however, goes almost without saying.

Alligators are hunted for their teeth, which find a ready market when made up into pretty ornaments; and of late years extensively for their hides, which make a very handsome leather. For this purpose the older specimens are not valuable, their hides being too gnarled, knotty, and moss-grown to tan well. After ten or fifteen years the hide coarsens. It is always the skin from the under side of the body and head which is used, that from the back being so heavily armored with tough, horny plates and shields as to be practically useless. The flesh for food finds but few admirers. Like the eggs, it is permeated by a strong, musky flavor, too rank to find appreciation from a refined palate; but in some places the steaks from the reptile are eaten by the negroes and pronounced good.

To successfully hunt the alligator requires experience, for quick work is necessary, the brute disappearing at the least suspicion of danger. Hunting by "jack" is the usual method pursued, for the light seems to charm the creature, so that he may be more easily detained until a properly directed bullet speedily puts an end to his existence.

A professional alligator hunter, or a "'gator man," as he is called, leads a life full of adventure, but his business is upon the wane, since the fad for alligator leather is being pushed aside to make way for something later and more novel. Nevertheless, a description of his outfit may not be uninteresting.

A most important adjunct to this outfit is the man who usually accompanies the 'gator man upon his expeditions. He might properly be called the silent partner, for his duty is to instantly and silently obey the different hand signals, meaning "To the right," "To the left," "Stop," "Back," "Hurry," "Forward," "Spurt," "Slow," given by the hunter, while standing erect in the bow of the boat, when out with the "jack." Indeed, upon his alertness depends much of the success or failure of the night's work.

The other tools used by the 'gator man are a light, strong boat, a pair of light oars and a broad-bladed paddle with a four-foot handle, neatly coiled rope, a jack lamp furnished with a powerful reflector, an axe, a long, keen-bladed hunting knife, two guns (twelve-bore breech-loaders, for a heavy charge at one delivery is absolutely necessary), bags of ammunition, some strong chains, rawhide rope, and a 'gator pole. This last-mentioned "tool" is a stout pole about ten feet long, armed with a heavy hook of quarter-inch iron, bearing a barbed shank of two inches or more, and it is used for hauling the dead alligators from the bottom, for the creatures sink as soon as killed.

The brilliant rays from the "jack" reveal a curious and a grewsome sight when thrown upon a bank or island upon which a group of the creatures have congregated. The shining waters of the swamp, so still and black at that hour of midnight; the hideous tangle of huge gray forms, as a dozen or more alligators, fairly intoxicated by the gleam of the mysterious light, steadfastly watch its incomprehensible presence. Gazing intently, their evil eyes blood-red in the glare from the powerful reflector, some lie motionless, others roar and hiss and snort with thrilling fierceness as the mystery deepens, incessantly arching their bodies, then alternately depressing them to the ground. Still others, crawling from beneath their companions, scuffle angrily to the front, and stand with jaws partly open—now and then slowly inflating their lungs, until their throats and sides puff out like bellows. Yet, strange to say, instinct seems to warn the mother alligator, for there she may be seen quietly creeping away with her young.

Then, the loud reports from the guns, and the mystery is dispelled! The island is deserted, and the work of raising the successfully shot saurians begins.

Boards of rural engineering, syndicates of specialists organized in several of the countries of northern Europe to look after drainage and irrigation, have rendered great services to the populations of the country districts. With their aid 591 villages in Alsace-Lorraine were provided with water between 1881 and 1895, and 516 communes in Baden have been benefited by their assistance. The expense of the improvement has not exceeded \$6.61 (33 francs) per inhabitant. The Agricultural Bureau in Prussia has in the past five years drawn the plans and directed the work of 554 hydraulic syndicates, covering a total surface of more than 600,000 acres. A numerous body of these agricultural engineers is formed every year in Germany, 517 students having pursued the course of the section of rural engineering in 1893 in the agronomical institutes of Bonn and Berlin alone.

It is generally accepted that the spider is a solitary animal, that will tolerate no companions, even the male being in danger of being devoured by his female. But a spider—the *Stregodyphus gregarius*—is described as living in the Transvaal in communities, including males and females, young and old. The nests are sometimes voluminous and have partitions and numerous passages running through them. The spiders usually escape observation by wrapping themselves in dry leaves that hang from stems.

THE RACIAL GEOGRAPHY OF EUROPE.

A SOCIOLOGICAL STUDY.

(*Lowell Institute Lectures, 1896.*)

By WILLIAM Z. RIPLEY, Ph. D.,
ASSISTANT PROFESSOR OF SOCIOLOGY, MASSACHUSETTS INSTITUTE OF TECHNOLOGY; LECTURER IN ANTHROPO-GEOGRAPHY AT COLUMBIA UNIVERSITY.

SUPPLEMENT.—THE JEWS (*continued*).

TRADITION has long divided the Jewish people into two distinct branches: the Sephardim, or southern, and the Ashkenazim or north, European. Mediaeval legend among the Jews themselves traced the descent of the first from the tribe of Judah; the second, from that of Benjamin. The Sephardim are mainly the remnants of the former Spanish and Portuguese Jews. They constitute in their own eyes an aristocracy of the nation. They are found primarily to-day in Africa; in the Balkan states, where they are known as Spagnuoli; less purely in France and Italy. A small colony in London and Amsterdam still holds itself aloof from all communion and intercourse with its brethren. The Ashkenazim branch is numerically far more important, for the German, Russian, and Polish Jews comprise over nine tenths of the people, as we have already seen in our preceding article.

Early observers all describe these two branches of the Jews as very different in appearance. Vogt, in his Lectures on Man, assumes the Polish type to be descended from Hindu sources, while the Spanish alone he held to be truly Semitic. Weisbach * gives us the best description of the Sephardim Jew as to-day found at Constantinople. He is slender in habit, he says; almost without exception the head is "exquisitely" elongated and narrow, the face a long oval; the nose hooked and prominent, but thin and finely chiseled; hair and eyes generally dark, sometimes, however, tending to a reddish blond. This rufous tendency in the Oriental Jew is emphasized by many observers. Dr. Beddoe † found red hair as frequent in the Orient as in Saxon England, although later results do not fully bear it out.‡ This description of a reddish Oriental type corresponds certainly to the early representations of the Saviour; it is the type, in features, perhaps, rather than hair, painted by Rembrandt—the Sephardim in Amsterdam being familiar to him, and appealing to the artist in preference to the Ash-

* 1877, p. 214.

† 1861 b, pp. 227 and 331.

‡ Glück, 1896 a. Jacobs, 1890, p. 82, did not find a trace of it in the Sephardim congregation in London. See Andree, 1878, in this connection.

kenazim type. This latter is said to be characterized by heavier features in every way. The mouth, it is alleged, is more apt to be large, the nose thickish at the end, less often clearly Jewish, perhaps. The lips are full and sensual, offering an especial contrast to the thin lips of the Sephardim. The complexion is swarthy oftentimes, the hair and eyes very constantly dark, without the rufous tendency which appears in the other branch. The face is at the same time fuller, the breadth corresponding to a relatively short and round head.

Does this contrast of the traditional Sephardim and Ashkenazim facial types correspond to the anthropometric criteria by means of which we have analyzed the various populations of Europe? And, first of all, is there the difference of head form between the two which our descriptions imply? * And, if so, which represents the primitive Semitic type of Palestine? The question is a crucial one. It involves the whole matter of the original physical derivation of the people, and the rival claims to purity of descent of the two branches of the nation. In preceding papers we have learned that western Asia is quite uniformly characterized by an exceeding broad-headedness, the cephalic index—that is to say, the breadth of the head in percentage of the length from front to back—often rising to 86. This is especially marked in Asia Minor, where some of the broadest and shortest crania in the world are to be found. The Armenians, for example, are so peculiar in this respect that their heads appear almost deformed, so flattened are they at the back. A head of the description appears in the case of our Jew from Ferghanah on our second portrait page, 344. On the other hand, the peoples of African or negroid derivation form a radical contrast, their heads being quite long and narrow, with indices ranging from 75 to 78. This is the type of the living Arab to-day. Its peculiarity appears in the prominence of the occipital region in our Arab and other African portraits. Scientific research upon these Arabs has invariably yielded harmonious results. From the Canary Islands,† all across northern Africa,‡ to central Arabia itself,# the cephalic indices of the nomadic Arabs agree closely. They denote a head form closely allied to that of the long-headed Iberian races, typified in the modern Spaniards, south Italians, and Greeks. It was the head form of the ancient Phœnicians and Egyptians also, as has re-

* The cephalic index by which we measure the head-form is merely the breadth of the head in percentage of its length from front to back. The index rises as the head becomes relatively more broad.

† Verneau, 1881 a, p 500.

‡ Pruner Bey, 65 b; Gillebert d'Hercourt, 1868, p. 9; and especially Collignon, 1887 a, pp. 326–339; Bertholon, 1892, p. 41; also Collignon, 1896 b.

\# Eliséev, 1883.

cently been proved beyond all question.* Thus does the European Mediterranean type shade off in head form, as in complexion also, into the primitive anthropological type of the negro. The situation being thus clearly defined, it should be relatively easy to trace our modern Jews, if, indeed, as has so long been assumed, they have remained a pure and undefiled race during the course of their incessant migrations. We should be able to trace their origin if they possess any distinctive head form, either to the one continent or the other, with comparative certainty.

During the last quarter of a century about twenty-five hundred Jews have submitted their heads to scientific measurement. These have naturally for the most part been taken from the Great Russian and Polish branch; a few observers, as Lombroso, Ikof, Jacobs, Glück, and Livi, have taken observations upon a more or less limited number from southern Europe. For purposes of comparison we have reproduced in our footnote a summary of all the results obtained thus far. Inspection of the table shows a surprising uniformity. Ikof's limited series of Spagnuoli from Constantinople, and that of the Jews from Caucasia and Daghestan, are the only ones whose cephalic index lies outside the limits of 80 to 83. In other words, the Jews,

Authority.	Place.	Number.	Cephalic Index.
Lombroso, 1894 a	Turin, Italy.	112	82.0
Weisbach, '77	Balkan states.	19	82.2
Majer and Kopernicki, '77	Galicia.	316	83.6
Blechmann, '82	W. Russia.	100	83.2
Stieda, '83 (Dybowski)	Minsk, Russia.	67	82.2
Ikof, '84	Russia.	120	83.2
Ikof, '84	Constantinople.	17 crania.	74.5
Ikof, '84	Crimea.	30 crania (Karaim).	83.3
Majer and Kopernicki, '85	Galicia.	100	81.7
Jacobs, '90	England.	363	80.0
Jacobs, '90	England (Sephardim).	51	
Talko-Hyrncewicz, '92	Lithuania.	713	
Chantre, '95	Caucasia.	34	85.0
Weissenberg, '95	South Russia.	100	82.5
Weissenberg, '95	South Russia.	50 women.	82.4
Glück, '96	Bosnia (Spagnuoli).	55	80.1
Livi, '96	Italy.	34	81.6
Elkind, '97	Poland.	325	Men, 81.9 Women, 82.9
Deniker, '98	Daghestan.	19	87.0

wherever found in Europe, betray a remarkable similarity in head form, the crania being considerably broader than among the peoples of Teutonic descent. As we know, the extremes of head form in Europe, measured by the cephalic index, extend from 74 to 89; we thus observe that the Jews take a place rather high in the European

* Bertholon, 1892, p. 43; Sergi, 1897 a, chapter i, and even more recently Fouquet, 1896 and 1897, on the basis of De Morgan's discoveries.

Arab. Index, 76.

Musselman, Tunis. Index, 75.

Jew, Tunis Index, 75.

African Semitic Types.

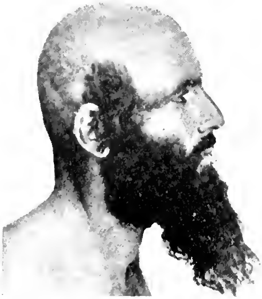
series. They are about like the northern French and southern Germans. More important still, they seem to be generally very closely akin in head form to the people among whom they reside. Thus, in Russia and Poland scarcely an appreciable difference exists in this respect between Jews and Christians. The same is true in Turin, while in the direction of Asia our Jews are as bullet-headed as even the most typical Armenians and Caucasians round about them.

This surprising similarity of head form between the Jews of North and South Europe bears hard upon the long-accepted theory that the Sephardim is dolichocephalic, thereby remaining true to the original Semitic type borne to-day by the Arabs. It has quite universally been accepted that the two branches of the Jews differed most materially in head form. From the facial dissimilarity of the two a correlative difference in head form was a gratuitous inference. Dr. Beddoe observes that in Turkey the Spagnuoli "seemed" to him to be more dolichocephalic. A few years later Barnard Davis (1867) "suspected" a diversity, but had only three Italian skulls to judge from, so that his testimony counts for little. Then Weisbach (1877) referred to the "exquisitely" long heads of the Spagnuoli, but his data show a different result. Ikof, with his small series of crania from Constantinople, is the only observer who got a result which accords in any degree with what we know of the head form of the modern Semitic peoples. On the other hand, Glück in Bosnia and Livi in Italy find no other sign of long-headedness than a slight drop in index of a point or two. Jacobs, in England, whose methods, as Topinard has observed, are radically defective, gives no averages for his Sephardim, but they appear to include about eleven per cent less pure long-headed types than even their Ashkenazim brethren in London. This, it will be noted, is the exact opposite of what might normally be expected. This tedious summary forces us inevitably to the conclusion that, while a long-headed type of Sephardim Jews may exist, the law is very far from being satisfactorily established.

Thus, from a study of our primary characteristic—the proportions of the head—we find our modern Jews endowed with a relatively much broader head than that of the average Englishman, for example: while the best living representative of the Semitic race, the Arab, has a head which is even longer and narrower than our own type. It is, in short, one of the longest known, being in every way distinctly African. The only modern Jews who even approach this type would seem to be those who actually reside to-day in Africa, as in the case of our two portrait types from that region. Two possible explanations are open to us: either the great body of the Jews in Europe to-day—certainly all the Ashkenazim, who form upward of ninety per cent of the nation, and quite probably the Sephardim also, except possibly those in Africa—have departed widely from the parental type in Palestine; or else the original Semitic type was broad-headed, and, by inference, distinctly Asiatic in derivation; in which case it is the modern Arab which has deviated from its original pattern. Ikof is the only authority who boldly faces this dilemma, and chooses the Asiatic hypothesis with his eyes open.* Which, we leave it to the reader to decide, would be the more likely to vary—the wandering Jew, ever driven from place to place by constant persecution, and constantly exposed to the vicissitudes of life in densely populated cities, the natural habitat of the people, as we have said; or the equally nomadic Arab, who, however, seems to be invariable in type, whether in Algeria, Morocco, the Canary Islands, or Arabia Felix iself? There can be but one answer, it seems to us. The original Semitic stock must have been in origin strongly dolichocephalic—that is to say, African as the Arabs are to-day; from which it follows, naturally, that about nine tenths of the living Jews are as widely different in head form from the parent stock to-day as they well could be. The boasted purity of descent of the Jews is, then, a myth. Renan (1883) is right, after all, in his assertion that the ethnographic significance of the word Jew, for the Russian and Danubian branch at least, long ago ceased to exist. Or, as Lombroso observes, the modern Jews are physically more Aryan than Semitic, after all. They have unconsciously taken on to a large extent the physical traits of the people among whom their lot has been thrown. In Algiers they have remained long-headed like their neighbors, for, even if they intermarried, no tendency to deviation in head form would be provoked. If, on the other hand, they settled in Piedmont, Austria, or Russia, with their moderately round-headed populations, they became in time assimilated to the type of these neighbors as well.

Nothing is simpler than to substantiate the argument of a constant intercourse and intermixture of Jews with the Christians about them all through history, from the original exodus of the forty thousand (?) from Jerusalem after the destruction of the second temple. At this time the Jewish nation às a political entity ceased to exist. An important consideration to be borne in mind in this connection, as Neubauer suggests very aptly, is that opposition to mixed marriages was primarily a prejudice of religion and not of race. It was dissipated on the conversion of the Gentile to Judaism. In fact, in the early days of Judaism marriage with a nonbeliever was not in-

* Compare Brinton, 1890 a, p. 132, and 1890 b, for interesting linguistic data on the Semites.



Ferghanah, Turkestan.

Hérault, France.

Elizabethgrad, Russia.

Spagnuoli, Bosnia.

Elizabethgrad, Russia.

Jewish Types.

valid at all, as it afterward became, according to the Jewish code. Thus Josephus, speaking of the Jews at Antioch, mentions that they made many converts, receiving them into their community. An extraordinary number of conversions to Judaism undoubtedly took place during the second century after Christ. As to the extent of intermarriage which ensued during the middle ages discussion is still rife. Renan, Neubauer, and others interpret the various rigid prohibitions against intermarriage of Jews with Christians—as, for example, at the church councils of 538, 589, at Toledo, and of 743 at Rome—to mean the prevalent danger of such practices becoming general; while Jacobs, Andree, and others are inclined to place a lower estimate upon their importance. Two wholesale conversions are known to have taken place: the classical one of the Khozars, in South Russia, during the reign of Charlemagne, and that of the Falashas, who were neighboring Arab tribes in Yemen. Jacobs has ably shown, however, the relatively slight importance of these. It is probable that the greatest amount of infusion of Christian blood must have taken place, in any event, not so much through such striking conversions, as insidiously through clandestine or irregular marriages.

We find, for example, much prohibitive legislation against the employment of Christian servants by Jews. This was directed against the danger of conversion to Judaism, by the master, with consequent intermarriage. It is not likely that these prohibitions were of much avail, for, despite stringent laws in Hungary, for example, we find the archbishop of that country reporting in 1229 that many Jews were illegally living with Christian wives, and that conversions by thousands were taking place. In any case, no protection for slaves was ever afforded. The confinement of the Jews strictly to the Ghettos during the later centuries would naturally discourage such intermixture of blood, as also the increasing popular hatred between Jew and Chrisian; but, on the other hand, the greater degree of tolerance enjoyed by the Israelites even during this present century would be competent speedily to produce great results. Jacobs has strenuously, although perhaps somewhat inconclusively, argued in favor of a substantial purity of the Jews by means of a number of other data—such as, for example, by a study of the relative frequency of Jewish names, by the supposed relative infecundity of mixed marriages, and the like. Experience and the facts of everyday observation, on the other hand, tend to confirm us in the belief that racially no purity of descent is to be supposed for an instant. Consider the evidence of names, for example. We may admit a considerable purity, perhaps, to the Cohns and Cohens, legitimate descendants of the Cohanim, the sons of Aaron, early priests of the temple. Their marital relations were safeguarded against infusion of foreign blood in every possible way. The name is, perhaps, in its various forms, the most frequent among Jews to-day. But how shall we account for the equally pure Jewish names in origin, such as Davis, Harris, Phillips, and Hart? How did they ever stray so far from their original ethnic and religious significance, unless the marital bars were lowered to a large degree? Some of them certainly claim a foremost position numerically in our Christian English directories. We have an interesting case of indefinite Jewish delimitation in our portraits. The middle portrait at page 341 is certainly a Jewish type. Dr. Bertholon writes me that all who saw it immediately asserted it to be a Jew. Yet the man was a professed Mussulman, in fact, even though his face was against him.

There is, as we have sought to prove, no single uniform type of head peculiar to the Jewish people which may be regarded as in any sense racially hereditary. Is this true also of the face? Our first statement encounters no popular disapproval, for most of us never, perhaps, happened to think of this head form as characteristic. But the face, the features! Is this another case of science running counter to popular belief?

The first characteristic to impress itself upon the layman is that the Jew is generally a brunette. All scientific observers corroborate this impression, agreeing in that the dark hair and eyes of this people really constitute a distinct racial trait. About two thirds of the Ashkenazim branch in Galicia and Russia, where the general population is relatively quite blond, is of the brunette type, this being especially marked in the darker color of the hair. For example, Majer and Kopernicki,* in Galicia, found dark hair to be about twice as frequent as the light. Elkind,† in Warsaw, finds about three fifths of the men dark. In Bosnia, Glück's observations on the Sephardim type gave him only two light-haired men out of fifty-five. In Germany and Austria‡ this brunette tendency is likewise strongly emphasized. Pure brunette types are twice as frequent in the latter country, and three times as frequent in Germany, among Jewish as among Christian school children. Facts also seem to bear out the theory, to which we have already alluded, that the Oriental Jews betray a slightly greater blond tendency, thus inclining to rufous. In Germany also the blond tendency becomes appreciably more frequent in Alsace-Lorraine, a former center of gravity of the nation, as the map in our previous article has shown. This comparative blondness of the Alsatian Jew is not new, for in 1861 the origin of these same blondes was matter of controversy. Broca believed them to be of northern deriva-

* 1877, pp. 88–90; 1885, p. 34. † Centralblatt für Anthropologie, vol. iii, p. 66.

‡ Virchow, 1886 b, p. 364; Schimmer, 1884, p. xxiii.

tion, while Pruner Bey traced them from a blondish Eastern source. The English Jews seem also to be slightly lighter than their continental brethren, even despite their presumably greater proportion of Sephardim, who are supposed to be peculiarly dark. As to the relative red blondness of the Oriental Jew, the early observations of Dr. Beddoe, and those of Langerhans (1873) as to the blue eyes and red-brown hair of the Druses of Lebanon, do not seem to be borne out; or, as Jacobs puts it, the "argument may be dismissed with costs." Certainly the living Semites are dark enough in type, and the evidence of the sacred books bears out the same theory of an original dark type. Thus "black" and "hair" are commonly synonymous in the early Semitic languages. In any case, whatever the color in the past, we have seen that science corroborates the popular impression that the Jews as a people are distinctively of a brunette type. This constitutes one of the principal traits by which they may be almost invariably identified. It is not without interest to notice that this brunetteness is more accentuated, oftentimes, among the women, who are, the world over, persistent conservators of the primitive physical characteristics of a people.*

Secondly, as to the nose. Popularly the humped or hook nose constitutes the most distinctive feature of the Jewish face. Observations among the Jews, in their most populous centers, do not, however, bear out the theory. Thus Majer and Kopernicki (1885), in their extended series, found only nine per cent of the hooked type—no greater frequency than among the Poles; a fact which Weissenberg confirms as to the relative scarcity of the convex nose in profile among his South Russian Jews. He agrees, however, that the nose is often large, thick, and prominent. Weisbach (1877) measured the facial features of nineteen Jews, and found the largest noses in a long series of people from all over the earth; exceeded in length, in fact, by the Patagonians alone. The hooked nose is, indeed, sometimes frequent outside the Jewish people. Olechnowicz found, for example, over a third of the noses of the gentry in southeast Poland to be of this hooked variety. Running the eye over our carefully chosen series of portraits, selected for us as typical from four quarters of Europe—Algeria, Russia, Bosnia, and the confines of Asia—representing the African, Balkan Spagnuoli, and Russian Ashkenazim varieties, visual impression will also confirm our deduction. The Jewish nose is not so often truly convex in profile. Nevertheless, it must be confessed that it gives a hooked impression. This seems to be due to a peculiar "tucking up of the wings," as Dr. Beddoe expresses it. Herein lies the real distinctive quality about it, rather than in any

* Weissenberg, 1895, p. 567, finds brunettes twice as frequent among the south Russian Jewesses as among the men.

convexity of outline. In fact, it often renders a nose concave in profile, immediately recognizable as Jewish. Jacobs * has ingeniously described this "nostrility," as he calls it, by the following diagrams: Write, he says, a figure 6 with a long tail (Fig. 1); now remove the turn of the twist, and much of the Jewishness disappears; and it vanishes entirely when we draw the lower continuation horizontally, as in Fig. 3. Behold the transformation! The Jew has turned Roman beyond a doubt. What have we proved, then? That there is in reality such a phenomenon as a Jewish nose, even though it be differently constituted from our first assumption. A moment's inspection of our series of portraits will convince the skeptic that this trait, next to the prevalent dark hair and eyes and the swarthy skin, is the most distinctive among the chosen people.

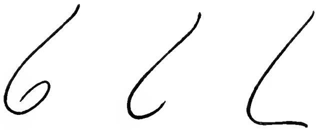


Fig. 1. *Fig. 2.* *Fig. 3.*

Another characteristic of the Jewish physiognomy is the eyes. The eyebrows, seemingly thick because of their darkness, appear to be nearer together than usual, arching smoothly into the lines of the nose. The lids are rather full, the eyes large, dark, and brilliant. A general impression of heaviness is apt to be given. In favorable cases this imparts a dreamy, melancholy, or thoughtful expression to the countenance; in others it degenerates into a blinking, drowsy type; or, again, with eyes half closed, it may suggest suppressed cunning. The particular adjective to be applied to this expression varies greatly according to the personal equation of the observer. Quite persistent also is a fullness of the lips, often amounting in the lower one almost to a pout. The chin in many cases is certainly rather pointed and receding, Jacobs to the contrary notwithstanding. A feature of my own observation, perhaps not fully justified, is a peculiar separation of the teeth, which seem to stand well apart from one another. But a truce to speculations. Entering into greater detail, the flat contradictions of different observers show that they are vainly generalizing from an all too narrow base of observations. Even the fancied differences in feature between the two great branches of the Hebrew people seem to us to be of doubtful existence. Our portraits do not bear it out. It seems rather that the two descriptions of the Ashkenazim and Sephardim types which we have quoted denote rather the distinction between the faces of those of the upper and the lower classes. Enough for us to know that there is a something Jewish in these faces which we instantly detect. We recognize it in Rembrandt's Hermitage, or in Munkaczy's Christ before Pilate. Not invariable

* 1886 a, p. xxxii.

are these traits. Not even to the Jew himself are they always a sure criterion. Weissenberg gives an interesting example of this.* To a friend, a Jew in Elizabethgrad, he submitted two hundred and fifty photographs of Russian Jews and Christians in undistinctive costume. Seventy per cent of the Jews were rightly chosen, while but ten per cent of the Russians were wrongly classed as Jews. Of what concern is it whether this characterization be entirely featural, or in part a matter of expression? The first would be a matter of direct heredity, the second hypothesis partakes more of the nature of a characteristic acquired from the social environment. Some one—Jacobs, I think—speaks of it as the "expression of the Ghetto." It certainly appears in the remarkable series of composite Jewish portraits published in his monograph. It would not be surprising to find this true. Continued hardship, persecution, a desperate struggle against an inexorable human environment as well as natural one, could not but write its lines upon the face. The impression of a dreary past is deep sunk in the bodily proportions, as we have seen. Why not in the face as well?

We are now prepared, in conclusion, to deal with what is perhaps the most interesting phase of our discussion. It is certainly, if true, of profound sociological importance. We have in these pages spoken at length of the head form—primary index of race; we have shown that there are Jews and Jews in this respect. Yet which was the real Jew it was not for us to decide, for the ninety-and-nine were broad-headed, while the Semite in the East is still, as ever, a long-headed member of the Africanoid races. This discouraged our hopes of proving the existence of a Jewish cephalic type as the result of purity of descent. It may indeed be affirmed with certainty that the Jews are by hereditary descent from early times no purer than most of their European neighbors. Then we discovered evidence that in this head form the Jews were often closely akin to the people among whom they lived. In long-headed Africa they were dolichocephalic. In brachycephalic Piedmont, though supposedly of Sephardim descent, they were quite like the Italians of Turin. And all over Slavic Europe no distinction in head form between Jew and Christian existed. In the Caucasus also they approximate closely the cranial characteristics of their neighbors. Hypnotic suggestion was not needed to find a connection here, especially since all history bore us out in our assumption of a large degree of intermixture of Gentile blood. Close upon this disproval of purity of type by descent came evidence of a distinct uniformity of facial type. Even so impartial an observer as Weissenberg—certainly not prejudiced in favor of cephalic invariability—confesses this featural unity.

* 1895, p. 563.

How shall we solve this enigma of ethnic purity, and yet impurity, of type? In this very apparent contradiction lies the grain of comfort for our sociological hypothesis. The Jew is radically mixed in the line of *racial descent;* he is, on the other hand, the legitimate heir to all Judaism as a matter of *choice.* It is for us a case of purely artificial selection, operative as ever only in those physical traits which appeal to the senses. It is precisely analogous to our example of the Basques in France and Spain. What we have said of them will apply with equal force here. Both Jews and Basques possessed in a high degree a "consciousness of kind"; they were keenly sensible of their social individuality. The Basques primarily owed theirs to geographical isolation and a peculiar language; that of the Jews was derived from the circumstances of social isolation, dependent upon the dictates of religion. Another case in point occurs to us in this connection. Chantre,* in a recent notable work, has shown the remarkable uniformity in physical type among the Armenians. They are so peculiar in head form that we in America recognize them at once by their foreshortened and sugar-loaf skulls, almost devoid of occiput. They too, like the Jews, have long been socially isolated in their religion. Thus in all these cases, Basques, Armenians, and Jews, we have a potent selective force at work. So far as in their power lay, the individuality of all these people was encouraged and perpetuated as one of their dearest possessions. It affected every detail of their lives. Why should it not also react upon their ideal of physical beauty? and why not influence their sexual preferences, as well as to determine their choice in marriage? Its results became thus accentuated through heredity. But all this would be accomplished, be it especially noted, only in so far as the physical traits were consciously or unconsciously impressed upon them by the facts of observation. There arises at once the difference between artificial selection in the matter of the head form and that concerning the facial features. One is an unsuspected possession of individuality, the other is matter of common notice and, it may be, of report. What Jew or Christian, till he became anthropologist, ever stopped to consider the shape of his head, any more than the addition of a number of cubits to his stature? Who has not, on the other hand, early acquired a distinct concept of a Jewish face and of a distinctly Jewish type? Could such a potent fact escape observation for a moment?

We are confirmed in our belief in the potency of an artificial selection, such as we have described, to perpetuate or to evolve a Jewish facial type by reason of another observation. The women among the Jews, as Jacobs † notes, in confirmation of our own belief, be-

* Recherches anthropologiques dans l'Asie Occidentale (Archives du Museum d'histoire naturelle, Lyons, vol. vi, 1895).

† 1886 a, p. xxviii.

tray far more constantly than the men the outward characteristics peculiar to the people. We have already cited Weissenberg's testimony that brunetteness is twice as prevalent among Russian Jewesses as among the men. Of course this may be a matter of anabolism, pure and simple. This would be perhaps a competent explanation of the phenomenon for physiologists like Geddes and Thompson. For us this other cause may be more directly responsible. Artificial selection in a social group, wherein the active choice of mates falls to the share of the male, would seem to tend in the direction of an accentuated type in that more passive sex on which the selective influence directly plays. At all events, observations from widely scattered sources verify the law that the facial individuality of a people is more often than otherwise expressed most clearly in the women. Thus, for example, the women betray the Mongol type more constantly than the men among the Asiatic tribes of eastern Russia.* On the other hand, Mainof, best of authority, confirms the same tendency among those of Finnic descent.† The *Setti Communi* in northern Italy still preserve their German language as evidence of a historic Teutonic descent. They seem to have lost their identity entirely in respect of the head form,‡ but Ranke # states that among the women the German facial type constantly reappears. This, I confess, is not altogether easy to understand, unless the Lombards, of whom these colonies are supposedly the remnants, brought their native women with them across the Alps. Perhaps, however, not bringing their women, a new Teutonic resemblance has been evolved out of whole cloth. A better example than this is offered among the Hamitic peoples of Africa north of the Sahara. These peoples, from Abyssinia to Morocco, really belong to the white races of Europe. Among nearly all their tribes the negroid traits are far more accentuated among the women, according to Sergi.‖ It is not necessary to cite more specific testimony. The law occupies a respected place among anthropologists. That the Jews confirm it, would seem to strengthen our hypothesis at every point.

Our final conclusion, then, is this: It is paradoxical, yet true, we affirm. The Jews are not a race, but only a people, after all. In their faces we read its confirmation, while in respect of their other traits we are convinced that such individuality as they possess—by no means inconsiderable—is of their own making from one generation to the next, rather than as a product of an unprecedented purity of physical descent.

* Sommier, 1887, reprint, p. 116. Cf. Zograf, 1896, p. 50, on crania from the sixteenth century in Moscow.

† Congrès int. des sciences géographiques, Paris, 1875, p. 268.

‡ Livi, 1896 a, pp. 137 and 146.

Beiträge zur Anth. Bayerns, vol. ii, 1879, p. 75.

‖ Africa, Antropologia della stirpe Camitica, Torino, 1897, p. 263.

TRUE TALES OF BIRDS AND BEASTS.

By DAVID STARR JORDAN.

I.—SEÑOR ALCATRAZ.

HE was just a bird when he was born, and a very ugly bird at that. For he had big splay feet, with all the toes turned forward and joined together in one broad web, and his wings were thick and clumsy, and underneath his long bill there was a big red sack that he could fill with fishes, and when it was full he could hardly walk or fly, so large the sack was and so great was his appetite.

But he kept the sack well filled and he emptied it out every day into his stomach, and so he grew very soon to be a large bird, as big as a turkey, though not as fat, and each day uglier than ever.

But one morning, when he was walking out on the sand flat of the Astillero at Mazatlan, Mexico, where he lived, he saw a big fish which had been left by the falling tide in a little pool of water. It was a blue-colored fish with a big bony head, and no scales, and a sleek, slippery skin. He did not know that it was a *bagre*, but he thought that all fishes were good to eat, so he opened his mouth and slipped the fish, tail first, down into his pouch. It went all right for a while, but when the fish woke up and knew he was being swallowed, he straightened out both of his arms, and there he was. For the bagre is a kind of catfish, and each arm is a long, stiff, sharp bone, or spine, with a saw edge the whole length of it. And all the bagre has to do is just to put this arm out straight and twist it at the shoulder and then it is set, and no animal can bend or break it. And it pierced right through the skin of the bird's sack, and the bird could not swallow it, nor make it go up nor down, and the bagre held on tight, for he knew that if he let go once he would be swallowed, and that would be the last of him.

So the bird tried everything he could think of, and the fish held on, and they kept it up all day. In the afternoon a little boy came out on the sands. His name was Inocente, and he was the son of Ygnacio, the fisherman of Mazatlan. And Inocente took a club of mangrove and ran up to the struggling bird and struck it on the wing with the club. The blow broke the wing, and the bird lay down to die, for with a broken wing and a fish that would not go up nor down, there was no hope for him.

When Inocente saw what kind of a fish it was, he knew just what to do. He reached down into the bird's sack and took hold of the fish's spines. He gave each one a twist so that it rolled over in its socket, the upper part toward the fish's head, and then they were not stiff any more, but lay flat against the side of the fish, just as they ought to lie. Then the fish knew that it had found a master, and lay perfectly still. So the bird gave a great gulp, and out the bagre went on the sand, and when the tide came up it swam away, and took care never to go again where a bird could get hold of it. And the bird with the broken wing had learned something about fishes, too. But he could not fly away, so he waited to see what the boy was going to do.

The boy took the bird into his boat and brought him home. And old Ygnacio put a splint on his wing and covered it with salve, and by and by it healed. But the bone was set crooked, and the bird could not fly very well. So the boys called the bird Señor Alcatraz, which is the Spanish for Mr. Pelican, and Señor Alcatraz and all the boys and dogs and goats became good friends, and all ran about on the streets together. And when the boys would shout and the dogs bark, all Señor Alcatraz could do was to squawk and hiss and open his big mouth and show the inside of his red fish sack.

And when the boys would go fishing on the wharf, Alcatraz would go, too, and he would stow away the fishes in his pouch as fast as the boys could catch them. But if they caught a bagre fish, he would turn his head the other way and then run away home just as fast as his splay feet would take him.

And when the men drew the net on the beach Alcatraz would splash around inside the net, catching whatever he could, and having a great deal of fun in his clumsy pelican fashion. Then he would run along the street with the boys, squawking and flapping his wings and thinking that he was just like the rest of them. And if you ever go to Mazatlan, ask for Dr. Rogers, and he will show you the way to Ygnacio's cabin on the street they call Libertad. And there in the front yard, in a general scramble of dogs, goats, and little Indian boys, you will see Señor Alcatraz romping and squabbling like the best of them. And you will know which he is by the broken wing and the red sack under his throat. But if you say "Bagre" to him, he will run under the doorstep and hide his face till you go away.

II.—THE LITTLE BLUE FOX.

Once there was a little blue fox, and his name was Eichkao, and he was a thief. So he built his house down deep among the rocks under the moss on the Mist Island, and his little fox children used to stay down among the rocks. There they would gurgle, gurgle, gurgle, whenever they heard anybody walking over their heads. Eichkao and his fox wife used to run all round over the rocks to find something for them to eat, and whenever Eichkao saw anybody coming he would go clin-n-n-g, cling-g-g, and his voice was high and sharp, just like the voice of a buzz saw.

One day he walked out on the rocks over the water and began to talk to the black sea parrot, whose name is Epatka, and who sits erect on his carelessly built nest with one egg in it, and wears a great big bill made of red sealing wax. He has a long white quill pen stuck over each ear, and over his face is a white mask, so that nobody can know what kind of a face he has, and all you can see behind the mask is a pair of little foolish twinkling white glass eyes. What the two said to each other I don't know, but they did not talk very long, for in a few minutes when I came back to his house among the rocks Eichkao was gone, and there lay out on the bank a bill made of red sealing wax, a white mask, and two little white quill pens. There were a few bones and claws and some feathers, but they did not seem to belong to anything in particular, and the little foxes in the rocks went gurgle, gurgle, gurgle.

One day I lay down on the moss out by the old fox walk on the Mist Island, and Eichkao saw me there and thought I was some new kind of walrus which might be good to eat, and would feed all the little foxes for a month. So he ran around me in a circle, and then he ran around again, then again and again, always making the circle smaller, until finally the circle was so narrow that I could reach him with my hand. As he went around and around, all the time he looked at me with his cold, gray, selfish eye, and not one of all the beasts has an eye as cruel-cold as his. When he thought that he was near enough, he gave a snap with his jaws, and tried to bite out a morsel to take home to the little foxes; but all I offered him was a piece of rubber boot. And when I turned around to look at him he was running away as fast as he could, calling klin-n-g-g, klin-n-g, klin-n-g, like a scared buzz saw all the time as he went out of sight. And I think that he is running yet, while the little foxes still go gurgle, gurgle under the rocks.

III.—HOW THE RED FOX WENT HUNTING.

(*With acknowledgment to Mr. A. C. Bassett, of Menlo Park, California.*)

Once on a time there was a great tall rabbit, the kind the miners call a "narrow-gauge mule"; but he was not a mule at all, and his real name was "Jack Rabbit." His home was in Montana, and he lived by the river they call the Silver Bow. He could run faster than any of the other beasts, and he went lickety-clip, lickety-clip, bounding over the tops of the sagebrush, for he had no brush of his own to carry.

And there was a red fox who lived on the Silver Bow, too, and he went hunting because he wanted rabbit for dinner. But while he could run very fast he could not bound over the tops of the sagebrush, for his own brush, which he always carried with him because he was so proud of it, would catch on the thorns of the other kinds of brush and so would keep him back.

So he sent for his cousin, the coyote, to come and help him. Now, the coyote lived out in the country by Emigrant Mountain. He was not proud at all, for he hadn't much of a brush, and nobody flattered him for his beauty. But for all that the coyote could run very fast, as he had Indian blood in him. The only trouble was that his hind feet ran faster than his fore feet. So he had to stop every little while and run sidewise to unkink himself and give his fore feet a chance to catch up.

When the coyote came up the rabbit was bounding along through the bushes, going around in a great circle so that he always came back to the same place, for that is the way of the rabbit-folk. So the fox lay low and hid his brush in the sage, and the coyote followed the rabbit around the circle. And he just kept up with the rabbit all the way, for the rabbit wasn't scared, and didn't run very fast. And when they had gone once around the circle the rabbit passed the hidden fox. Then the fox got up and chased him, and was only a few feet behind. And the coyote stopped and ran sidewise for a while to unkink himself, and then he lay down in the bushes and waited for the rabbit to come back. The rabbit was much scared when he saw the fox close behind him, so he ran and bounded very fast, and the fox kept falling behind because he had his long brush to carry. But he kept at it just the same, and when the rabbit came around the circle to where he started there was the coyote waiting for him. The rabbit had to make a great jump to get over the coyote's head. Then they went around again and the coyote kept close behind all the way, and the rabbit began to get tired. When the coyote's hind legs got tangled up then the fox was rested, and he took up the chase; and so they kept on, each one taking his turn, except the rabbit, who had to keep his own turn all the time.

When the race was over there was nobody there to see how they divided up what they caught. But I saw the coyote the next day, and he looked so very empty that I think that the red fox must have taken all the rabbit meat for himself. Most likely he left his cousin just the ears for his part, with a rabbit's foot to carry in his pocket for good luck.

GLACIAL GEOLOGY IN AMERICA.

By Prof. DANIEL S. MARTIN.

UNDER this title the vice-president of Section E (Geology) of the American Association—Prof. Herman L. Fairchild, of the University of Rochester, New York—gave an admirable *résumé* of the whole history, progress, and scope of the study of ice phenomena in North America, as the opening address before the section at the recent Boston meeting. Apart from the interest of the subject in itself considered, this address was a model of what such addresses should be. While strictly scientific, without the least attempt at rhetorical effect, it was at the same time so clear, so well arranged and so simple in language, that any intelligent auditor could enjoy it and grasp it, and carry away a distinct impression of the gradual development and present status of this great department of geological study. Professor Fairchild's choice of his subject was happy also in its fitness to the occasion, as covering almost exactly the half century of the life of the association, though going back indeed a few years further, into the period of the earlier society which developed into the association in 1848.

The great body of phenomena comprised under the term "drift," and the smoothed and scratched surfaces of rock, etc., had been by no means unnoticed by the early students of American geology, but they were attributed to violent and widespread water action, and were spoken of in general as "diluvial" formations. When the agency of ice began to be recognized, it was regarded as that of floating and stranding bergs; and this view for a long time contended with the theory of glacial action, even when the latter had been adopted and advocated by eminent students of the subject.

The first allusion to drifting ice as the agent of transportation of bowlders, etc., appears to have been made as early as 1825, by one Peter Dobson, of Connecticut, in a letter to Prof. Benjamin Silliman, of Yale College. Sir Roderick Murchison, who became the great champion of this view, credits Mr. Dobson's letter with giving him the first suggestion of it. Twelve years later, in 1837, T. A. Conrad made the earliest reference to land ice as the cause of our drift phenomena; he does this in very striking words when read in the light of the studies and determinations of later years, although of course imperfectly and vaguely.

Meanwhile, however, Agassiz and others had been working among the glaciers of the Alps, and their views as to a great period of former extension, in Europe and the British Isles, were finding some acceptance abroad. In this country, Prof. Edward Hitchcock, in his address as retiring president of the Association of American Geologists, in 1841, gave a broad and careful review of the drift phenomena in eastern North America, and referred to the work of Agassiz, Buckland, and Lyell with great interest, as having given him "a new geological sense" in observing these phenomena, and said, with prophetic foresight, "Henceforth, glacial action must form an important chapter in geology."

But the time was not ripe for the understanding and acceptance of the glacial theory as a later generation has come to know it. The studies of Agassiz and his *confrères* had been among glaciers upon mountain slopes, and hence, while many of the drift phenomena were strikingly accounted for, others were not and could not be. So it came to pass that, while Professor Hitchcock and others in this country were strongly impressed, they were not satisfied, and held for years an uncertain position. The glacial indications conformed in some aspects to the theory, but not in others; the striæ and groovings, instead of following valleys, all had a general trend to the southward, and the bowlders were carried across great depressions and deposited upon heights. How could these conditions be due to glaciers? Could ice flow uphill, or move long distances over level areas? These and other phenomena, such as the peculiar distribution of drift material, in "drumlin" ridges and the like, had no explanation. Hence, notwithstanding President Hitchcock's utterances above quoted, and his similar Postscript on the subject of drift and moraines, appended in the same year to his volume on the Geology of Massachusetts, we find him in 1843, when again addressing the Association of Geologists, adopting a modified tone, dwelling upon these points of difficulty, and seeking a compromise view, which he called "glacio-aqueous." The great influence also of Murchison and Lyell had been thrown into the scale in favor of the iceberg theory, and this fact doubtless had much to do with the slow development of true conceptions. Lyell visited America in 1842, and was present at the American Geologists' meeting, advocating the floating-ice doctrine, to which most of our observers already leaned; and so the views of Agassiz and the glacial school had to wait for a decade before they found general acceptance or even audience.

This, we may note in passing, is but one marked instance out of many in the history of science, wherein the personal influence of eminent leaders has obstructed and retarded the advance of true knowledge. The whole recognition of the Cambrian system, as pre-Silurian and distinct, was suppressed and prevented for many years by Murchison's intense opposition to the views of Sedgwick. Similar facts might be cited in this country, did we care to mention names. Science can not claim, as is sometimes asserted, that it possesses or imparts any entire exemption from the influence of authority, and bestows complete independence from the tendency to "swear to the words of a master."

Of the New York geologists, Vanuxem alone, in his Geology of the Third District, 1842, inclined to the glacial theory; the others—Emmons, Mather, and Hall—advocated floating ice, the latter urging as a chief objection the absence of any great northern highlands from which glaciers could extend southward. Prof. Henry D. Rogers advocated De la Beche's view, of great catastrophic waves or *débacles* of water and ice, produced by sudden uplifts of the floor of a circumpolar ocean, and sweeping southward with tremendous power over the middle latitudes. These views were presented by him in 1844, at the Washington meeting of the geologists, and are to us a most curious illustration of the old "cataclysmic" phase of geological conceptions.

Two years later Agassiz came to America, and at once set about studying the ice evidences here, first in the White Mountains and then around the Great Lakes. At the first meeting of the American Association, in 1848, he presented his views as to the identity of our phenomena with those studied by himself, Desor, and Guyot abroad. His views were not very warmly received, however, and he did not attempt their public presentation again for some years, turning his attention more to the field of zoölogy. In 1850, in a work on Lake Superior, he refers somewhat sharply to the prejudice that seemed to prevail in relation to this subject.

From this time, however, the aqueous theories began to be less strongly presented; and a new generation of geologists was coming on, largely under the training of Guyot and Agassiz, and more open to their observed results. C. B. Adams, in 1850, presented a view nearly akin to that adopted by Dana a few years later, of an elevation of the high northern latitudes, resulting in a southward-moving glacial sheet, and a subsequent depression connected with its retreat, to account for the stratified deposits. Professor Dana accepted this doctrine in his presidential address before the association in 1855, adding the "Terrace period" of partial re-elevation. From this time he became the leader of the American glacialists, and his great Manual, issued in 1862, carried these views into all the colleges of the country.

In 1857 Prof. Edward Hitchcock published an important treatise on Surface Geology, particularly of the Connecticut Valley, in the Smithsonian Contributions to Knowledge. In this paper he noted the distinction, so important and now so familiar, between local striæ and those with the general southward course of the "drift." Two years later his son, Prof. C. H. Hitchcock, extended this distinction widely over New England. In 1863 the report of progress of the Geological Survey of Canada gave an extended review of the surface geology, by Prof. Robert Bell, in which he fully adopted the glacial theory. Meantime, also, Professor Ramsay, in England, had abandoned the iceberg doctrine for that of glaciers.

In 1866 and 1867 important papers appeared by Charles Whittlesey, and one by Edward Hungerford; this last, read before the association, adopted the general views of Agassiz, with some important limitations now generally received. In the same year the revised edition of Dana's Manual gave yet fuller statement and wider diffusion to the generally accepted views as held to-day.

Professor Fairchild sums up this historical sketch as comprising four periods—viz., prior to 1841, undisputed reign of diluvial hypotheses; 1841 to 1848, suggestion and discussion of glacial hypotheses; 1849 to 1866, gradual acceptance of the latter view; from 1867 onward, development of glacial geology.

From this point, the address was occupied with consideration of the various aspects of the subject as studied and wrought out during the past twenty years by numerous observers. These are grouped under four main heads, each with various subdivisions—viz., (1) the ice sheet, as to its area, its thickness, its centers of dispersion, its migration of centers, etc.; (2) the ice period, as to its cause, its divisions, its duration, its distance in time; (3) the interpretation of special phenomena, such as moraines, drumlins, eskers, "kettles," and the like, valley drift, terraces, loess, etc.; and (4) existing glaciers, as discovered on our high mountains of the far West, and as studied in closer relation to the ancient phenomena in the great ice cap of Greenland and the immense glacier development in Alaska.

It is impossible to go into a detailed review of the numerous points of interest covered in this discussion. Suffice it to say that one who heard or who reads it finds an admirably clear and condensed account of all the problems and phenomena that have been and that are now encountered in the study of glacial geology on this continent, and of their gradual interpretation and solution by the combined labors of many students. The progress of knowledge over this wide field, advancing step by step, amid conflicting views and perplexing conditions, is beautifully shown, and leaves a very striking impression on the mind, of the difficulties and the successes of scientific research. Nor is Professor Fairchild disposed to claim too much or assert too strongly. He recognizes that, with all that has been met and mastered, there are still questions unsolved, and laurels to be won by others.

Among the facts brought out, a few may be briefly alluded to. The early abandonment of Agassiz's original view of a vast extension of the polar snow caps, and the recognition of separate centers of continental glaciation, now distinctly determined as three in number—a western, a central, and an eastern—the former being the earliest, and the others following in succession; the recognition by the Western geologists of the twofold character of the Glacial epoch, as also determined in western Europe, but less markedly traceable in our Eastern States, though now generally admitted; in close relation to this the determination of the line of the great terminal moraine, traced by successive observers from the Atlantic seaboard to Minnesota, and the subsequent recognition of an older, eroded, and fragmentary morainal "fringe," marking the line of the earlier ice sheet, somewhat beyond the later. With regard to the actual distance of the last glacial retreat, as expressed in years, Professor Fairchild is both cautious and frank. He notes the general consensus of recent observers toward a much shorter period than was formerly supposed—from five to ten or perhaps fifteen thousand years. At the same time, there are many elements of uncertainty involved, and the problem is by no means settled. The Niagara gorge, so long looked upon as a possible chronometer, grows more complicated as it is further studied; the rate of erosion has evidently varied much with the volume of water carried by the river; and this, in turn, has varied with the changes of level, and consequently of drainage routes, in the basin of the Great Lakes. There have been times when only the Erie waters flowed through the Niagara outlet, the upper lake drainage passing eastward independently, until a gradual northern rise of the land, which is proved to be still going on, turned the entire drainage into the present St. Clair route from Lake Huron into Lake Erie, and so through Niagara.

This point leads us to digress for a moment from the address under consideration to allude to a very interesting department of study that is now growing into prominence—to wit, the restoration of pre-glacial geography and hydrography, and the genesis of our existing river and lake systems throughout the northern part of the country. The discussions and results in regard to Niagara and the Great Lakes are somewhat familiar, but the work on the rivers and smaller lakes is not so widely known. Professor Fairchild himself has done much in relation to the "central lakes" of New York State; and one very interesting paper of this kind on The Development of the Ohio River was read before the section by Prof. William G. Light, of Granville, Ohio, besides many papers by others on similar topics.

The work done within a few years upon the glaciers of Arctic

America has proved peculiarly fruitful in results. Here, again, the whole subject is reviewed historically, and the name and work of each observer are impartially noted. Much of the difficulty encountered by the glacial theory arose, as we have seen, from the fact that only mountain glaciers had been studied, so that many of the phenomena produced by continental ice could not be explained. Professor Fairchild says, as to this aspect: "More has been learned of the structure, behavior, and work of our ancient ice sheets by the study of the Alaskan glaciers during the last ten years, and especially by the study of the Greenland ice cap during the last four years, than by all the study of the Alpine glaciers for the seventy years since they have been observed." Prominent among those who have worked in this field are the names of Professors Chamberlain and Salisbury in Greenland, and Professors H. F. Reid and I. C. Russell in Alaska; other important contributors are Prof. W. P. Blake, the pioneer geologist in Alaska, 1867; Dall and Baker, who discovered and named the Malaspina Glacier in 1874; and John Muir, 1878, for whom the Muir Glacier was named; Wright, Baldwin, Schwatka, Libbey, and others, and Barton and Tarr in Greenland.

Professor Russell, in 1891, recognized and named a type of glacier that was before unknown. In his studies on the Malaspina he found a condition that does not occur, so far as yet observed, anywhere else than on the northwest coast of America; this is where a number of mountain glaciers debouch upon a low, flat coast plain, and unite to form a great sluggishly moving sheet of ice. This particular development he called the Piedmont type.

In closing his address, Professor Fairchild remarks that the word "theory," as applied to the glacial origin of the drift and its phenomena, may and should now be abandoned. The subject has passed beyond the stage of theory, and is as well understood and as clearly established as the volcanic origin of the cone of Vesuvius or the sedimentary origin of stratified rocks.

In the center of the artificial platforms or platform mounds, characteristic of many of the ancient Peruvian towns, Mr. Bandelier has observed features that recall forcibly the New Mexican Indian custom of giving to each inanimate object its heart. In some instances, says Mr. F. W. Hodge, in his paper, round columns formed a kind of an interior niche; in others, a small chamber contained urns or jars with maize meal. A remarkable and very significant feature was observed by the explorer in a partly ruined mound at Chanchan. The core of this structure when opened showed two well-preserved altars of adobe. In such interior apartments, figurines of metal, clay, or wood are almost invariably found; and the materially valuable finds made in Peruvian ruins in earlier times came from the "heart" of one or the other of the artificial elevations described.

MODERN STUDIES OF EARTHQUAKES.

By GEORG GERALAND.

THE investigation of earthquakes, seismology, has become in the present day an independent subject of scientific interest. In lands where earthquakes are frequent, as in Italy and Japan, seismic observations have been officially systematized over the whole country, with central and branch stations at which the work is never still. A net of seismic observations of all nations is being more and more closely woven over the whole earth, and there are yearly and monthly collations of observations of even the slightest shocks. Seismic literature is, therefore, nearly inexhaustible, and theory and praxis are in constant vogue; in short, seismics has grown to be a separate branch of science, and to demand independent treatment, calling for the energy and labor of many students. What gives it so great importance? What is the condition of our present knowledge and its history? What will be reached in the future through the competition of the nations? These questions possess a high scientific as well as culture-historical interest. We here attempt to answer them.

The first really scientific description of an earthquake—that of Lisbon—with its far-reaching accompanying phenomena, was the work of the greatest contemporary thinker, Kant, and it is not too much to say that his paper opened a new epoch in the knowledge of earthquakes. That terrible event and the extreme terror which it caused everywhere were followed in 1783 by the likewise extremely destructive earthquake of Calabria. The attention of the people was thus directed to this mysterious mighty activity of the earth, and was kept especially lively in Italy, the country of Europe most subject to earthquakes. The newly rising science of geology therefore found in the last third of the last century in these phenomena a problem of prominent importance. Geologists were the first to apply themselves to seismic studies, as the most widely current explanation of the phenomena is still a geological one. The scientific interest of the question prevailed over the practical. More attentive observation was given to earthquakes, the accounts of them scattered through the ancient chronicles were collated, and the already very numerous seismic notes of great earthquake manifestations—such as those by Hoff, Perry, Mallet, Volger, Fuchs, etc.—constituted a very important factor in the study. One of the earliest results of the inquiry was to show that directly perceptible earthquakes are not perceptible everywhere; that they are most common on the great upfoldings of the earth's crust on the mountain chains, such as the Andes, Alps, and Himalayas; and that, further, they are connected with the shores of the Pacific, the Antilles, and the Mediterranean, and with places also where great breaches and various disturbances are evident; that they are at home likewise in volcanoes; and that they are most frequent in the northern hemisphere, and when the earth is nearest to the sun. The descriptions of powerful shocks furnish us evidence of a double movement of the earth's crust—an alternate up-and-down vibration and an often very marked wave motion. The destruction which earthquake shocks and waves inflict on buildings, and the remarkably rapid and wide spread of the tremblings over the surface of the earth, have been very diligently inquired into; and when, in 1856, Naples and Calabria were visited by a great earthquake, an English investigator, Robert Mallet, made a full study of it, and believed that by comparing the direction of the rents in walls and buildings, which were assumed to correspond with that of the tremblings, he could identify the focus of the shocks in the earth's interior, and the course of the wave movement over its surface—a view which has long prevailed in seismology. Still more important was the work of the geologist Karl von Seebach, of Göttingen, on the great earthquake in central Germany, which kept the northern part of the plains of the upper Rhine, around Mayence, Grossgerau, and Darmstadt, disturbed for several years after 1869. Von Seebach's chief effort was to obtain the most exact data possible as to the time of the beginning of the shocks from as many places as possible, from which he might deduce the spot where the shocks began and were strongest, the epicenter which lay directly over the point in the earth's interior where the movement originated. From them he also deduced a series of localities where the shocks were simultaneous and of equal intensity, which could be connected by certain nearly circular lines called *homoseists*. As the distance of these from the epicenter increases, the undulations take place later and are weaker, and facts may be thus furnished from the velocity of propagation of the shocks can be computed. The observations are also important because von Seebach undertook through a simple mathematical calculation to determine from them the situation of the forces of the subterranean point where the undulations originated.

With these investigations, the process of annihilating time and space by steam and the applications of electricity was also going on. By the effect of this great event, the conditions of earthquake investigation were revolutionized. A comparative study of the phenomena, fundamental and essential to a science of seismology, on the basis of material furnished from all the regions of the earth, was rendered possible. An earthquake service was organized in Japan, by J. Milne, of England; one had already been organized for a considerable time in Italy, and the results obtained at the two places of observation so widely separated corresponded. Japanese, Indian, and American earthquakes could be simultaneously studied in Italy, Russia, Germany, and England; and thus a new, hitherto undeveloped field was gained, the scope of which has already extended far beyond its merely geological aspect.

This could have happened only through another advance that has been made in our century, which has first rendered a real seismology, a scientific knowledge of the seismic conditions of the earth, possible through the immense development of technics, by which a system of instrumental observation of earthquakes was established. Only through this could the acquisitions of recent times be utilized. While formerly observations were macroscopic and touched only earthquakes that could be directly felt, they now cover essentially microscopic tremors of the earth's crust, of less than a thousandth of a millimetre, that are wholly imperceptible to human senses; and we can read them, enlarged at our pleasure, on our photographically registering seismometers. We already had instruments which correctly indicated the time of the beginning and possibly the direction of a shock; but we needed and have invented new instruments—various sorts of horizontal and vertical pendulums—for the observation and representation of the whole course of the movement. The vertical indicating instruments are much used in Italy, and the horizontal ones almost exclusively in England, Japan, and Germany. The horizontal pendulum was invented in Germany in 1832 by Hengler, adapted to scientific use by Professor Zöllner, of Leipsic, and afterward applied in that form by English, German, and other observers. The most complete shape and the one best adapted to extremely delicate seismic observations was given to it by the late German astronomer and geographer Dr. Ernst von Rebeur Paschnitz, of Merseburg. Having undergone a few small changes, fixed in a threefold combination it serves as our most sensitive and accurate seismometer. Its movements and its very exact time markings are photographically represented. The pendulum box is only forty centimetres in diameter. In consequence of its convenience and cheapness, its self-action and its serviceability, it is becoming adopted more and more generally as an international instrument.

Microseismic investigation and its wide extension over the earth have raised seismology another step during the last twenty years, so that it may be said that really exact seismic research began with it. Modern seismology has confirmed many of the older results, such as the localization of earthquakes on the shores of the Pacific, the Mediterranean and in the mountain chains of the earth, and also the importance of homoseists and the epicenter. It has, on the other hand, greatly modified the former estimates of the velocity of propagation of the shocks. It has cast much doubt on speculations as to the seasons in which earthquakes are more or less frequent; and it has demonstrated the inadequacy of former methods of determining the central focus. It has furthermore brought us much that is new. First is the momentous fact that the earth's crust is never at rest; that it undergoes a multitude of very diversified movements besides those of the earthquake. Thus a periodical swelling, a flood wave, is produced by the attraction of the moon; and other heavings are induced by the daily and annual course of the sun's heat. But such movements and other similar ones do not come within the scope of this article.

Real earthquakes, or movements that originate in the depths of the earth, also appear in very different forms. First are the directly perceptible shocks, from the powerful ones that create great disturbances to the merely local ones often hardly remarked. Of the immediate workings of these shocks, microscopic instruments have taught us nothing essentially new. But very many macroscopic movements, often continuing for several hours, but which are not felt, have been revealed, that have been shown in many instances to be distant effects of other strong earthquakes; effects which are sometimes propagated over the whole surface of the earth. There is, furthermore, another series of movements, only partly explained as yet, of a peculiar sort: first, small, quickly passing disturbances, which appear in the photographic reproductions of the curves as larger or smaller knots, and which are regarded with great probability as distant effects of minor seismic movements most likely imperceptible anywhere. They can not be local earthquakes, for they give entirely different curves. There also appear, with considerable regularity, at certain seasons of the year, very slow movements of the ground, called pulsations; and finally the multitude of vibrations called tremors, which assume various forms. Sometimes they come as forerunners, accompaniments, or followers in close association with those great disturbances that originate in distant earthquakes; sometimes as shocks of minute intensity in separate groups, which it has not yet been possible to account for; and in other cases they are traced to the shaking of the ground by the wind. It is hardly necessary to observe that the seismic apparatus should be most carefully guarded against disturbance by the movements of trade, wagons, etc., so that the problem shall not be complicated by them.

The theory of the nature of earthquake shocks, their transmission and their velocity, has been set in a new light by the labors of Augustus Smith, of Stuttgart. From some calculations of their velocity made by G. von Nebeur, it is found that the earthquake of April 17, 1889, in Tokio, Japan, was perceived in Potsdam, Prussia, nine thousand kilometres distant, in thirteen minutes; that of October 27, 1894, in Santiago, Chili, in Rome, eleven thousand five hundred kilometres distant, in seventeen minutes, and in Charkow, Russia, two thousand kilometres from Rome, between one and two minutes later. It reached Tokio at the same time, after a transit of seventeen thousand four hundred kilometres.

Still another task of modern seismology is the investigation of earthquakes at sea, or seismic movements of the bottom of the ocean, and the manner in which they are propagated through the water, of which a very fine cartographic representation has been published by Dr. C. Rudolph, of Strasburg.

The question of the origin of earthquakes stands in constant connection with this external development of seismology. It is significant and remarkable that the answers to it, though they may be given differently from different scientific points of view, are always consistent in one fact, that earthquakes are a phenomenon of the whole earth. Some of the investigators seek to explain them, aside from those that occur in volcanic regions, as a part of the great changes in the earth's crust which have taken place during the last geological epoch, and are still, perhaps, taking place; others find their seat and cause in the unstable condition of the interior of the earth, beneath its solid and red-hot envelope. The former explanation, the older and heretofore the prevalent one, is called the tectonic theory, because it is based, leaving out volcanic earthquakes, on the structure of the earth's crust; the second, which is gaining ground, and requires no separate explanation for volcanic earthquakes, may be called, reviving an expression used by L. Fr. Naumann, of Leipsic, the Plutonic theory, because it goes down into the unexplored depths of the earth. If seismic manifestations depend upon the action of the whole earth, a single explanatory principle, as is always the case with great natural phenomena, is not sufficient, and tectonic as well as Plutonic earthquakes must be recognized, and the reverse.

The tectonic theory is of geological origin, and properly supplanted the older Plutonic theory of Humboldt, which was only an unverified supposition. As a whole it was first worked out by Otto Volger in 1858, after various similar hypotheses had been set forth by other investigators. He was confirmed by the independent researches of Rudolf Hoernes, Edouard Suess, and most of the German, French, and English seismologists.

Their theory supposes that there are large hollow spaces in the crust of the earth, into which immense falls of material take place, and that these are the cause of a part of the earthquakes; that the crust of the earth is often and variously disturbed in consequence of the constant contraction dependent upon the cooling of the globe. It is broken up into separate masses which in their turn are dislocated horizontally or vertically; is lifted up and folded into immense mountain ranges, the arches of which, breaking, may again suffer dislocation. Thus continuous action in movement of masses and foldings is constantly going on in the earth. Edouard Suess, the distinguished Austrian geologist, has indeed constituted a special earthquake type to correspond with this type of mountain formation. Since, in consequence of this condition, tension is present everywhere in the crust of the earth, it may come to pass that it shall be relieved by a distant earthquake, and another earthquake, which may be called a relay or transmission earthquake, be produced thereby. Hence we have, besides the volcanic, the landfall, the tectonic (in the strict sense), and the transmission earthquakes. The sources of earthquake force lie, then, according to this theory, in the incompleteness of the earth's crust, the effects of gravity, and the earth's loss of heat.

And is the supposition not very probable? Do we not see similar processes going on over the whole earth, in the shape of earthquakes, landslides, fissures, subsidences of land, and the like? And as the Alps were lifted up, and the plain of the Rhine was depressed between the Vosges and the Black Forest, may not mightier dislocations, breaches, and destruction occur? Why may not the processes which took place in the earlier epochs of the earth's history and were so powerful in the more recent Tertiary be still going on? All this seems so plausible that, with a few exceptions, the theory has been almost universally agreed in.

I briefly mention here Falb's theory, which, accepting the earlier views, ascribes earthquakes to periodical swellings of the fiery fluid interior of the earth, only because of the effect it has had on the public in connection with some wholly unscientific predictions. More worthy of consideration is the theory of Daubrée, the late distinguished master of French and especially Alsatian geology, who did not attribute the similar phenomena of volcanic and nonvolcanic earthquakes to different causes, but maintained that all earthquakes were produced by superheated steam issuing from surface waters. But this theory needs no refutation. There are, however, some serious objections to the tectonic theory of earthquakes, plausible as it may seem. In order to weigh them as we ought, we must as briefly as possible construct a picture of the constitution of the earth's interior.

The average distance from the earth's surface to its center is sixty-three hundred and seventy kilometres. The temperature of the earth increases with the depth, at the rate, on a moderate estimate, of about one degree centigrade for every forty metres. Hence, at a depth of one thousand kilometres we would have a temperature of 25,000°

C.; even if we call it only 15,000°, we should expect to find there only gases, and those in a simple state, for with that heat all the compound gases would be dissociated. The zone of fluidity for all rocks lies at a depth of about one hundred kilometres, where the temperature is 2,500° C. While the crust of the earth is between 2.5 and three times as heavy as distilled water at 4° C., its specific gravity rises toward the center of the earth to more than eleven, or about fourfold. Iron has a specific gravity of 7.8, or about threefold that of the crust of the earth; but the specific gravity of the earth at the greatest depth is considerably higher than this. Hence must arise an enormous pressure, steadily increasing toward the center, where, according to the English geophysicist, the Rev. Osmond Fisher, it reaches about three million atmospheres to the English square inch. It results from these conditions that with the enormous pressure and heat, and specific gravity, the interior of the earth consists of dissociated gases compressed to great rigidity, which exert an immense counter-pressure—for their tendency is always to expand. They pass out continuously into a zone of fluid matter, and this again is held by the pressure of the interior gases in a like compact condition. Thus a very high pressure still prevails in the lower parts of the solid crust of the earth, which is so high that even the most solid rocks there are in a latent plastic condition—that is, they behave toward different forces like plastic clay, and like it can be deformed without breaking. Rents, slides, caves, and clefts are out of the question there; things of that kind can exist only in the upper strata.

This fact constitutes a very strong objection to the tectonic theory of earthquakes, and thus the very depths of the earth speak against it. We have already mentioned that K. von Seebach estimated the depth of the earthquake focus from the movements of the waves, and found it not very great. But his estimates, as Prof. August Schmidt has shown, rest upon physically incorrect premises; according to Schmidt's more correct calculation, the center of the Charleston earthquake of 1886 lay at a depth of one hundred and twenty kilometres, where there can be no question of tectonic movements, because general fluidity is reached at one hundred kilometres. Further, the earthquake at Lisbon, if the tectonic theory is valid, might, taking the character of the region into consideration, have been occasioned by a slide. But how large must the plunging mass, how deep the plunge or slide have been to produce such shocks as destroyed Lisbon and shook Europe to beyond Bohemia! Where can we find room in the closely compressed interior of the earth for such irruptions? Even if such a sudden sinking had left no trace in the interior, it should have left its marks on the surface. Mr. John Milne counts up not less than 8,331 considerable earthquake shocks in

Japan between 1885 and 1892; Julius Schmidt, former director of the observatory in Athens, enumerated three hundred severe and dangerous and fifty thousand light shocks for Phocis alone between 1870 and 1873, of which not a trace of land changes or depressions can be perceived, aside from superficial avalanches (on Parnassus, for example) and subsidence of meadows and other spongy soil, like the famous depression of the Molo at Lisbon.

All this speaks so emphatically against the tectonic origin of earthquakes that it can not be considered as a general cause. Even the mighty disturbances and shocks of the times when such ranges as the Alps and Himalayas were lifted up can prove nothing for the present time; for the conditions, the mechanical work and acting forces, of the earth were quite different, and the latter much greater and more acute than in our time, as the number and magnitude of the volcanoes of those ages show, before which ours are almost as nothing. We have no adequate comprehension of the way that mechanical work was done. A depression like that of the plain of the Rhine could certainly not have taken place without severe earthquakes; but we do not know how they may have come to pass, for we have nothing analogous to them. The upper strata of the earth's crust are broken up, fissured, and cavernous; hence purely local minor earthquakes may undoubtedly be produced by cavings-in, landslides, and settlings of small extent. But this explanation, in view of the nature of the crust, is not possible for strong earthquakes, even in the upper layers, which send their waves far over the land; their origin must be, almost of necessity, in the greater deeps beneath the crust, far down where the immense gas globe of the interior is constantly forcing its way into the fluid band, and this into the solid stone; in those zones of changing conditions a mighty movement must be incessantly prevailing. The pressure upon the gases of the interior diminishes here, and the excessive temperature as well. This can not take place without changes. Temperature and pressure now fall, now rise again, but continue very high through it all. The dissociated gases unite and separate again, and most violent explosions are infallibly produced thereby. Water exists in the interior in immense masses, and that not solely in consequence of percolation from the surface. Vapor at very high pressure separates into its elements—hydrogen and oxygen—the reunion of which ensues with violent explosions, similar to our gas explosions, which must be very numerous in the interior of the earth, and accompanied with great development of force. The principal effect of such explosions is, of course, against the cooler and more weakly resisting sides, and therefore not toward the interior but toward the crust and the weakest parts of it, toward the rupture lines of the zones of disturbance, the synclinals. Such attacks, striking the earth's crust from within, occasion most earthquakes, especially violent, destructive, deep-seated outbursts like those of Lisbon and Charleston. The relation of the seismic and the volcanic phenomena is clearly to be seen.

One series of seismic phenomena remains to be explained—the lighter undulations, the tremors, and the remarkable irregularity of the movements of the ground. The indications of the vertical pendulum apparatus which represent these movements form an inextricable tangle of lines running over and crossing one another. The late Japanese professor of seismology, Sekiya, prepared an enlarged model of the tracings of the seismic movements of a point of the earth's surface, which has been much copied. It represents an extremely confusing vibration of the lines.

Now we have to confront a very important fact which adds much to the difficulty of seismic research. We never feel and observe the earthquake shocks themselves, never directly in their simplicity or multiplicity, but only the wave movements that are sent out from them in the elastic crust of the earth. These, however multifold their origin, proceed in an immense spherical wave which moves in more or less numerous repetitions through the earth's interior. It is this shaking of the earth by the spherical waves that our instruments represent as earthquakes. We can not include as the earth's crust the surface of the earth on which we live, and which consists of loose materials disintegrated by weathering, breaking, and numerous causes, but the solid crust, often lying at a considerable distance beneath us, which bears these materials, and from which the spherical waves emerge. As the waves of the sea, beating upon the coast, are turned, split up, divided, thrown up, etc., in their surging, so surge, too, the seismic waves upon the disintegrated surface of shingle, pebbles, broken rocks, sand, and earth, in clefts and gorges. We thus never observe the original spherical waves, but only their fragmentary derivative forms, their resolution into numerous single waves which come to us diverted into the most various directions. It is thus most plainly shown that Mallet's effort to determine the center and origin of the earthquake from the direction of the shock was futile. We can only draw scientific conclusions respecting the time of beginning, the duration, and force of the movement. It is thus evident that many of the tremors (not all, by any means) originate in this division; that a fixed point of the earth's surface must describe a very complicated path in so intricate a wave movement; that the division is less marked on firm ground than on loose; that the former, in consequence of the more evenly protracted movement, is less dangerous than the latter; and that multiplied waves interfere, overlay, weaken, or strengthen one another just as water waves do. Thus are explained the earthquake bridges or spots which always remain unmoved through repeated earthquakes, either because they are firmer, or because the progress of the waves is arrested at them by interference.

The sounds, too, which so frequently accompany earthquakes are likewise simply results of this division of the waves and their escape into the air, for we perceive wave motions in the air as sound. The admirable delicacy of our sense of hearing is here manifested, for seismic movements are not rarely perceptible, or heard, as air waves, which we can not perceive as movements of the ground. Earthquake thunder is caused, like storm thunder, by shocks to the air, of which we hear the nearest and latest first, and the farthest and earliest last. The different tone shades of the earthquake sound depend upon their various sources, as from small, sharp fragments, clinking, rattling, and humming; from sand and earth, dull rumbling; from trees, whistling, etc. The echo in ravines not rarely operates to add strength to them. Earthquake sounds that seem to come out of the air from above are caused by earthquake waves reaching us by way of trees, houses, etc.; the different directions and degrees of force which they seem to indicate in different houses or in different rooms of the same house are explainable by the different elasticity conditions of the houses and rooms. But not the most insignificant conclusion can be drawn from these sounds concerning the nature and causes of earthquakes. It is important to emphasize this fact, for errors have often originated in conclusions drawn from such things.—*Translated for the Popular Science Monthly from the Deutsche Rundschau.*

Examples of a race of curiously protectively colored mice which inhabit the sandy island, the North Bull, in the Bay of Dublin, were exhibited by Dr. H. Lyster Jameson in the Zoölogical Section of the British Association. A considerable percentage of them were distinctly lighter hued than the ancestral type of house mouse, though every possible gradation occurred between the typical house mouse and the palest examples. The speaker regarded the marked predominance of sand-colored specimens as due to the action of natural selection. The hawks and owls which frequent the island, and are the only enemies the mice have to compete against, most easily capture the darkest examples, or those that contrast most strongly with the color of the sand. Thus a protectively colored race is becoming established. The island came into existence only about a hundred years ago. Consequently it is possible to fix a time limit within which the sandy-colored race has been evolved. Its evolution also, as Professor Poulton observed in his comment on Dr. Jameson's paper, gives additional evidence to that afforded by the shore crabs described by Professor Weldon in his presidential address to the section, that the transmutation of species is not necessarily so slow as to be indiscernible.

A SHORT HISTORY OF SCIENTIFIC INSTRUCTION.*

By J. NORMAN LOCKYER, K. C. B., F. R. S.

THE two addresses by my colleagues, Professors Judd and Roberts-Austen, have drawn attention to the general history of our college and the details of one part of our organization. I propose to deal with another part, the consideration of which is of very great importance at the present time, for we are in one of those educational movements which spring up from time to time and mold the progress of civilization. The question of a teaching university in the largest city in the world, secondary education, and so-called technical education are now occupying men's minds.

At the beginning it is imperative that I should call your attention to the fact that the stern necessities of the human race have been the origin of all branches of science and learning; that all so-called educational movements have been based upon the actual requirements of the time. There has never been an educational movement for learning's sake; but of course there have always been studies and students apart from any of those general movements to which I am calling attention; still we have to come down to the times of Louis Quatorze before the study of the useless, the *même inutile*, was recognized as a matter of national concern.

It is perhaps the more necessary to insist upon stern necessity as being the origin of learning, because it is so difficult for us now to put ourselves in the place of those early representatives of our race that had to face the problems of life among conditionings of which they were profoundly ignorant: when night meant death; when there was no certainty that the sun would rise on the morrow; when the growth of a plant from seed was unrecognized; when a yearly return of seasons might as well be a miracle as a proof of a settled order of phenomena; when, finally, neither cause nor effect had been traced in the operations of Nature.

It is doubtless in consequence of this difficulty that some of the early races have been credited by some authors with a special love of abstract science, of science for its own sake; so that this, and not stern necessity, was the motive of their inquiries. Thus we have been told that the Chaldeans differed from the other early races in having a predilection for astronomy, another determining factor being that the vast plains in that country provided them with a perfect horizon.

The first historic glimpses of the study of astronomy we find

* An address delivered at the Royal College of Science on October 6, 1898.

among the peoples occupying the Nile Valley and Chaldea, say 6000 B. C.

But this study had to do with the fixing of the length of the year, and the determination of those times in it in which the various agricultural operations had to be performed. These were related strictly to the rise of the Nile in one country and of the Euphrates in the other. All human activity was, in fact, tied up with the movements of the sun, moon, and stars. These, then, became the gods of those early peoples, and the astronomers, the seers, were the first priests; revered by the people because as interpreters of the celestial powers they were the custodians of the knowledge which was the most necessary for the purposes of life.

Eudemus of Rhodes, one of the principal pupils of Aristotle, in his History of Geometry, attributes the origin of geometry to the Egyptians, "who were obliged to invent it in order to restore the landmarks which had been destroyed by the inundation of the Nile," and observes "that it is by no means strange that the invention of the sciences should have originated in practical needs." * The new geometry was brought from Egypt to Greece by Thales three hundred years before Aristotle was born.

When to astronomy and geometry we add the elements of medicine and surgery, which it is known were familiar to the ancient Egyptians, it will be conceded that we are, in those early times, face to face with the cultivation of the most useful branches of science.

Now, although the evidence is increasing day by day that Greek science was Egyptian in its origin, there is no doubt that its cultivation in Greece was more extended, and that it was largely developed there. One of the most useful and prolific writers on philosophy and science who has ever lived, Aristotle, was born in the fourth century B. C. From him, it may be said, dates a general conception of science based on *observation* as differing from experiment. If you wish to get an idea of the science of those times, read his writings on Physics and on the Classification of Animals. All sought in Aristotle the basis of knowledge, but they only read his philosophy; Dante calls him the "master of those who know." †

Why was Aristotle so careful to treat science as well as philosophy, with which his master, Plato, had dealt almost exclusively?

The answer to this question is of great interest to our present subject. The late Lord Playfair ‡ in a pregnant passage suggests the reason, and the later history of Europe shows, I think, that he is right.

"We find that just as early nations became rich and prosperous,

* Greek Geometry from Thales to Euclid, p. 2. Allman.

† Inferno, canto iv, p. 130 *et seq.*

‡ Subjects of Social Welfare, p. 206.

so did philosophy arise among them, and it declined with the decadence of material prosperity. In those splendid days of Greece when Plato, Aristotle, and Zeno were the representatives of great schools of thought, which still exercise their influence on mankind, *Greece was a great manufacturing and mercantile community;* Corinth was the seat of the manufacture of hardware; Athens that of jewelry, shipbuilding, and pottery. The rich men of Greece and all its free citizens were actively engaged in trade and commerce. The learned class were the sons of those citizens, and were in possession of their accumulated experience derived through industry and foreign relations. Thales was an oil merchant; Aristotle inherited wealth from his father, who was a physician, but, spending it, is believed to have supported himself as a druggist till Philip appointed him tutor to Alexander. Plato's wealth was largely derived from commerce, and his master, Socrates, is said to have been a sculptor. Zeno, too, was a traveling merchant. Archimedes is perhaps an exception, for he is said to have been closely related to a prince; but if so, he is the only princely discoverer of science on record."

In ancient Greece we see the flood of the first great intellectual tide. Alas! it never touched the shores of western Europe, but it undoubtedly reached to Rome, and there must have been very much more observational science taught in the Roman studia than we generally imagine, otherwise how account for Pliny, the vast public works, their civilizing influence carried over sea and land from beyond Bab-el-Mandeb to Scotland? In some directions their applications of science are as yet unsurpassed.

With the fall of the Roman Empire both science and philosophy disappeared for a while. The first wave had come and gone; its last feebler ripples seem to have been represented at this time by the gradual change of the Roman secular studia wherever they existed into clerical schools, the more important of which were in time attached to the chief cathedrals and monasteries; and it is not difficult to understand why the secular (or scientific) instruction was gradually replaced by one more fitted for the training of priests.

It is not to be wondered at that the ceaseless strife in the center of Europe had driven what little learning there was to the western and southern extremities, where the turmoil was less—I refer to Britain and South Italy—while the exiled Nestorians carried Hellenic science and philosophy out of Europe altogether to Mesopotamia and Arabia.

The next wave—it was but a small one—had its origin in our own country. In the eighth century England was at its greatest height, relatively, in educational matters, chiefly owing to the labors of two men. Beda, generally called the Venerable Bede, the most eminent writer of his age, was born near Monkwearmouth in 673, and passed his life in the monastery there. He not only wrote the history of our island and nation, but treatises on the nature of things, astronomy, chronology, arithmetic, medicine, philosophy, grammar, rhetoric, poetry, music, basing his work on that of Pliny. He died in 735, in which year his great follower was born in Yorkshire. I refer to Alcuin. He was educated at the Cathedral School at York under Archbishop Egbert, and, having imbibed everything he could learn from the writings of Bede and others, was soon recognized as one of the greatest scholars of the time. On returning from Rome, whither he had been sent by Eaubald to receive the pallium, he met Karl the Great, King of the Franks and Lombards, who eventually induced him to take up his residence at his court, to become his instructor in the sciences. Karl (or Charlemagne) then was the greatest figure in the world, and although as King of the Franks and Lombards, and subsequently Emperor of the Holy Roman Empire, his court was generally at Aachen, he was constantly traveling throughout his dominions. He was induced, in consequence of Alcuin's influence, not only to have a school always about him on his journeys, but to establish, or foster, such schools wherever he went. Hence it has been affirmed that "France is indebted to Alcuin for all the polite learning it boasted of in that and the following ages." The universities of Paris, Tours, Fulden, Soissons, and others were not actually founded in his day, but the monastic and cathedral schools out of which they eventually sprang were strengthened, and indeed a considerable scheme of education for priests was established—that is, an education free from all sciences, and in which philosophy alone was considered.

Karl the Great died in 814, and after his death the eastward traveling wave, thus started by Bede and Alcuin, slightly but very gradually increased in height. Two centuries later, however, the conditions were changed. We find ourselves in presence of interference phenomena, for then there was a meeting with another wave traveling westward, and this meeting was the origin of the European universities. The wave now manifested traveling westerly, spread outward from Arab centers first and finally from Constantinople, when its vast stores of Grèek lore were opened by the conquest of the city.

The first wavelet justified Eudemus's generalization that "the invention of the sciences originated in practical needs," and that knowledge for its own sake was not the determining factor. The year had been determined, stone circles erected almost everywhere, and fires signaled from them, giving notice of the longest and shortest days, so that agriculture was provided for, even away from churches and the festivals of the Church. The original user of geometry was not required away from the valleys of the Nile, Tigris, and Euphrates, and therefore it is now medicine and surgery that come to the front for the alleviation of human ills. In the eleventh century we find Salerno, soon to be famed throughout Europe as the great medical school, forming itself into the first university. And medicine did not exhaust all the science taught, for Adelard listened there to a lecture on "the nature of things," the cause of magnetic attraction being one of the "things" in question.

This teaching at Salerno preceded by many years the study of the law at Bologna and of theology at Paris.

The full flood came from the disturbance of the Arab wave center by the crusades, about the beginning of the twelfth century. After the Pope had declared the "Holy War," William of Malmesbury tells us "the most distant islands and savage countries were inspired with this ardent passion. The Welshman left his hunting, the Scotchman his fellowship with vermin, the Dane his drinking party, the Norwegian his raw fish." Report has it that in 1096 no less than six millions were in motion along many roads to Palestine. This, no doubt, is an exaggeration, but it reflects the excitement of the time, and prepares us for what happened when the crusaders returned. As Green puts it:* "The western nations, including our own, 'were quickened with a new life and throbbing with a new energy.' . . . A new fervor of study sprang up in the West from its contact with the more cultured East. Travelers like Adelard, of Bath, brought back the first rudiments of physical and mathematical science from the schools of Cordova or Bagdad. . . . The long mental inactivity of feudal Europe broke up like ice before a summer's sun. Wandering teachers, such as Lanfranc or Anselm, crossed sea and land to spread the new power of knowledge. The same spirit of restlessness, of inquiry, of impatience with the older traditions of mankind, either local or intellectual, that drove half Christendom to the tomb of its Lord, crowded the roads with thousands of young scholars hurrying to the chosen seats where teachers were gathered together."

Studium generale was the term first applied to a large educational center where there was a guild of masters, and whither students flocked from all parts. At the beginning of the thirteenth century the three principal studia were Paris, Bologna, and Salerno, where theology and arts, law and medicine, and medicine almost by itself, were taught respectively; these eventually developed into the first universities.†

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* History of the English People, vol. i, p. 198.

† See Histoire de l'Université de Paris. Crévier, 1791, *passim*.

English scholars gathered in thousands at Paris round the chairs of William of Champeaux or Abélard, where they took their place as one of the "nations" of which the great middle-age university of Paris was composed.

We have only to do with the arts faculty of this university. We find that the subject-matter of the liberal education of the middle age there dealt with varied very little from that taught in the schools of ancient Rome.

The so-called "artiens," students of the arts faculty, which was the glory of the university and the one most numerously attended, studied the seven arts of the trivium and quadrivium—that is, grammar, rhetoric, dialectic and arithmetic, geometry, music, astronomy.*

This at first looks well for scientific study, but the mathematics taught had much to do with magic; arithmetic dealt with epacts, golden numbers, and the like. There was no algebra, and no mechanics. Astronomy dealt with the system of the seven heavens.

Science, indeed, was the last thing to be considered in the theological and legal studia, and it would appear that it was kept alive more in the medical schools than in the arts faculties. Aristotle's writings on physics, biology, and astronomy were not known till about 1230, and then in the shape of Arab-Latin translations. Still, it must not be forgotten that Dante learned some of his astronomy, at all events, at Paris.

Oxford was an offshoot of Paris, and therefore a theological studium, in all probability founded about 1167,† and Cambridge came later.

Not till the Reformation (sixteenth century) do we see any sign of a new educational wave, and then we find the two which have had the greatest influence upon the history of the world—one of them depending upon the Reformation itself, the other depending upon the birth of experimental inquiry.

Before the Reformation the universities were priestly institutions, and derived their authority from the Popes.

The universities were for the few; the education of the people, except in the various crafts, was unprovided for.

The idea of a general education in secular subjects at the expense of the state or of communities is coeval with the Reformation. In Germany, even before the time of Luther, it was undreamed of, or rather, perhaps, one should say, the question was decided in the negative. In his day, however, his zeal first made itself heard in favor of education, as many are now making themselves heard in

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* Enumerated in the following middle-age Latin verse:

"Lingua, tropus, ratio, numerus, tonus, angulus, astra."

† Universities of Europe in the Middle Ages, by Rashdall, vol. ii, p. 344.

favor of a better education, and in 1524 he addressed a letter to the councils of all the towns in Germany, begging them to vote money not merely for roads, dikes, guns, and the like, but for schoolmasters, so that all children might be taught; and he states his opinion that if it be the duty of a state to compel the able-bodied to carry arms, it is *a fortiori* its duty to compel its subjects to send their children to school, and to provide schools for those who without such aid would remain uninstructed.

Here we have the germ of Germany's position at the present day, not only in scientific instruction but in everything which that instruction brings with it.

With the Reformation this idea spread to France. In 1560 we find the States-General of Orleans suggesting to Francis II a "levée d'une contribution sur les bénéfices ecclésiastiques pour raisonablement stipendier des pédagogues et gens lettrés, en toutes villes et villages, pour l'instruction de la pauvre jeunesse du plat pays, et soient tenus les pères et mères, à peine d'amende, à envoyer les dits enfants à l'école, et à ce faire soient contraints par les segnieurs et les juges ordinaires."

Two years after this suggestion, however, the religious wars broke out; the material interests of the clerical party had predominated, the new spirit was crushed under the iron heel of priestcraft, and the French, in consequence, had to wait for three centuries and a revolution before they could get comparatively free.

In the universities, or at all events alongside them, we find next the introduction not so much yet of science as we now know it, with its experimental side, as of the scientific spirit.

The history of the Collége de France, founded in 1531 by Francis I, is of extreme interest. In the fifteenth century the studies were chiefly literary, and except in the case of a few minds they were confined merely to scholastic subtleties, taught (I have it on the authority of the Statistique de l'Enseignement Supérieur) in barbarous Latin. This was the result of the teaching of the faculties; but even then, outside the faculties, which were immutable, a small number of distinguished men still occupied themselves in a less rigid way in investigation; but still these studies were chiefly literary. Among those men may be mentioned Danès, Postel, Dole, Guillaume Budé, Lefèvre d'Étaples, and others, who edited with notes and commentaries Greek and Latin authors whom the university scarcely knew by name. Hence the renaissance of the sixteenth century, which gave birth to the Collége de France, the function of which, at the commencement, was to teach those things which were not in the ordinary curriculum of the faculties. It was called the Collége des Deux Langues, the languages being Hebrew and Greek.

It then became the Collége des Trois Langues, when the king, notwithstanding the opposition of the university, created in 1534 a chair of Latin. There was another objection made by the university to the new creation: from the commencement the courses were free; and this feeling was not decreased by the fact that around the celebrated masters of the Trois Langues a crowd of students was soon congregated.

The idea in the mind of Francis I in creating this Royal College may be gathered from the following edict, dated in 1545: "François, etc., savoir faisons à tous présents et à venir que Nous, considérant que le sçavoir des langues, qui est un des dons du Saint-Esprit, fait ouverture et donne le moyen de plus entière connaissance et plus parfaite intelligence de toutes bonnes, honnêtes, saintes et salutaires sciences. . . . Avons fait faire pleinement entendre à ceux qui, y voudraient vacquer, les trois langues principales, Hébraïque, Grecque, et Latine, *et les Livres esquels les bonnes sciences* sont le mieux et le plus profondément traitées. A laquelle fin, et en suivant le décret du concile de Vienne, nous avons piéça ordonné et establi en nôtre bonne ville de Paris, un bonne nombre de personnages de sçavoir excellent, qui lisent et enseignent publiquement et ordinairement les dites langues et sciences, maintenant florissant autant ou plus qu'elles ne firent de bien longtemps . . . auxquels nos lecteurs avons donné honnêtes gages et salaires, et iceux fait pourvoir de plusieurs beaux bénéfices pour les entretenir et donner occasion de mieux et plus continuellement entendre au fait de leur charge, . . . etc."

The Statistique, which I am following in this account, thus sums up the founder's intention: "Le Collége Royal avait pour mission de propager les nouvelles connaissances, les nouvelles découvertes. Il n'enseignait pas la science faite, il la faisait."

It was on account of this more than on account of anything else that it found its greatest enemy in the university. The founding of this new college, and the great excitement its success occasioned in Paris, were, there can be little doubt, among the factors which induced Gresham to found his college in London in 1574.

These two institutions played a great part in their time. Gresham College, it is true, was subsequently strangled, but not before its influence had been such as to permit the Royal Society to rise phœnixlike from its ashes; for it is on record that the first step in the forming of this society was taken after a lecture on astronomy by Sir Christopher Wren at the college. All connected with them felt in time the stupendous change of thought in the century which saw the birth of Bacon, Galileo, Gilbert, Hervey, Tycho Brahe, Descartes, and many others that might be named; and of these, it is well to remark, Gilbert,* Hervey, and Galileo were educated in medical schools abroad.

Bacon was not only the first to lay down *regulæ philosophandi*, but he insisted upon the far-reaching results of research, not forgetting to point out that "*lucifera experimenta, non fructifera quærenda*," † as a caution to the investigator, though he had no doubt as to the revolution to be brought about by the ultimate application of the results of physical inquiry.

As early as 1560 the Academia Secretorum Naturæ was founded at Naples, followed by the Lincei in 1609, the Royal Society in 1645, the Cimento in 1657, and the Paris Academy in 1666.

From that time the world may be said to have belonged to science, now no longer based merely on observation but on experiment. But, alas! how slowly has it percolated into our universities.

The first organized endeavor to teach science in schools was naturally made in Germany (Prussia), where, in 1747 (nearly a century and a half ago), Realschulen were first started; they were taken over by the Government in 1832, and completely reorganized in 1859, this step being demanded by the growth of industry and the spread of the modern spirit. Eleven hours a week were given to natural science in these schools forty years ago.

Teaching the Teachers.—Until the year 1762 the Jesuits had the education of France almost entirely in their hands, and when, therefore, their expulsion was decreed in that year, it was only a necessary step to create an institution to teach the future teachers of France. Here, then, we had the École Normale in theory; but it was a long time before this theory was carried into practice, and very probably it would never have been had not Rolland d'Erceville made it his duty for more than twenty years, by numerous publications, among which is especially to be mentioned his Plan d'Education, printed in 1783, to point out not merely the utility but the absolute necessity for some institution of the kind. As generally happens in such cases, this exertion was not lost, for in 1794 it was decreed that an École Normale should be opened at Paris, "ou seront appelés de toutes les parties de la République, des citoyens déjà instruits dans les sciences utiles, pour apprendre, sous les professeurs les plus habiles dans tous les genres, l'art d'enseigner."

To follow these courses in the art of teaching, one potential schoolmaster was to be sent to Paris by every district containing twenty thousand inhabitants. Fourteen or fifteen hundred young men therefore arrived in Paris, and in 1795 the courses of the school were opened first of all in the amphitheater of the Museum

* William Gilbert, of Colchester, on the Magnet. Mittelag, p. x.

† Novum Organum, vol. 1, p. 70. Fowler's edition, p. 255.

of Natural History. The professors were chosen from among the most celebrated men of France, the sciences being represented by Lagrange, Laplace, Haüry, Monge, Daubenton, and Berthollet.

While there was this enormous progress abroad, represented especially by the teaching of science in Germany and the teaching of the teachers in France, things slumbered and slept in Britain. We had our coal and our iron, our material capital, and no one troubled about our mental capital, least of all the universities, which had become, according to Matthew Arnold (who was not likely to overstate matters), mere *hauts lycées*, and "had lost the very idea of a real university"; * and since our political leaders generally came from the universities, little more was to be expected from them.

Many who have attempted to deal with the history of education have failed to give sufficient prominence to the tremendous difference there must necessarily have been in scientific requirements before and after the introduction of steam power.

It is to the discredit of our country that we, who gave the perfected steam engine, the iron ship, and the locomotive to the world, should have been the last to feel the next wave of intellectual progress.

All we did at the beginning of the century was to found mechanics' institutions. They knew better in Prussia, "a bleeding and lacerated mass"; † after Jena (1806), King Frederick William III and his councilors, disciples of Kant, founded the University of Berlin, "to supply the loss of territory by intellectual effort." Among the universal poverty money was found for the Universities of Königsberg and Breslau, and Bonn was founded in 1818. As a result of this policy, carried on persistently and continuously by successive ministers, aided by wise councilors, many of them the products of this policy, such a state of things was brought about that not many years ago M. Ferdinand Lot, one of the most distinguished educationists of France, accorded to Germany "a supremacy in science comparable to the supremacy of England at sea."

But this position has not been obtained merely by founding new universities. To Germany we owe the perfecting of the methods of teaching science.

I have shown that it was in Germany that we find the first organized science teaching in schools. About the year 1825 that country made another tremendous stride. Liebig demonstrated that science teaching, to be of value, whether in the school or the university,

* Schools and Universities on the Continent, p. 291.

† University Education in England, France, and Germany, by Sir Rowland Blennerhassett, p. 25.

must consist to a greater or less extent in practical work, and the more the better; that book work was next to useless.

Liebig, when appointed to Giessen, smarting still under the difficulties he had had in learning chemistry without proper appliances, induced the Darmstadt Government to build a chemical laboratory in which the students could receive a thorough practical training.

It will have been gathered from this reference to Liebig's system of teaching chemistry that still another branch of applied science had been created, which has since had a stupendous effect upon industry; and while Liebig was working at Giessen, another important industry was being created in England. I refer to the electric telegraph and all its developments, foreshadowed by Galileo in his reference to the "sympathy of magnetic needles."

Not only then in chemistry, but in all branches of science which can be applied to the wants of man, the teaching must be practical—that is, the student must experiment and observe for himself, and he must himself seek new truths.

It was at last recognized that a student could no more learn science effectively by seeing some one else perform an experiment than he could learn to draw effectively by seeing some one else make a sketch. Hence in the German universities the doctor's degree is based upon a research.

Liebig's was the *fons et origo* of all our laboratories—mechanical, metallurgical, chemical, physical, geological, astronomical, and biological.—*Nature.*

[*To be continued.*]

SHOULD CHILDREN UNDER TEN LEARN TO READ AND WRITE?

BY PROF. G. T. W. PATRICK.

THERE are certain propositions about education so evidently true that probably no parent or teacher would question them. For instance, the best school is one in which the course of study is progressively adapted to the mental development of the children. Again, certain subjects are adapted to children of certain ages or stages of development, and others are not. One would not recommend the study of logic or of the calculus to the average child of ten, nor would the teaching of English be wisely deferred until the age of fifteen. Finally, if the courses of study in our present school system shall be found to be arranged without regard to the order of mental development, they will sooner or later be modified in accordance with it.

Now the educational system in practice in the two or three hundred thousand public schools in the United States is a somewhat definite one, with a somewhat fixed order of studies through the different years or grades. In a majority of the States children are admitted to the schools at the age of six; in more than one third of the States children of five are admitted. In a general way we may say that during the first four years of school life the principal subjects occupying the time of the children are reading, writing, and arithmetic. To be more exact, we may cite, for instance, the city schools of Chicago.* Exclusive of recesses and opening exercises, there are in these schools thirteen hundred and fifty minutes of school work per week. Of this time, in the first and second grades, six hundred and seventy-five minutes are devoted to reading, seventy-five minutes to writing, and two hundred and twenty-five minutes to mathematics. Seventy-two per cent of the total time is therefore consumed by these subjects. In the third grade the proportion is the same; in the fourth grade it is somewhat more than fifty per cent. I have mentioned the Chicago schools because this is one of those school systems where a liberal introduction of other subjects, such as Nature study, physical culture, singing, and oral English, has somewhat lessened the time given to reading, writing, and arithmetic. Other cities, with few exceptions, will be found to give more rather than less time to these subjects. In the country schools, and indeed in a vast number of town and city schools, practically all the time during these early years is given to reading, writing, and arithmetic.

We must conclude, therefore, if our educational system is a rational one, that reading, writing, and arithmetic are the subjects peculiarly adapted to the mind of the child between the ages of five and ten. It is worth while to inquire from the standpoint of child psychology whether this be true. It should be observed, in the first place, that the manner in which our educational system has grown up is no guarantee that it rests upon a psychological basis. Our schools are exceedingly conservative. Any innovations or radical changes are resisted by the parents of the children even more strenuously than by school boards, superintendents, and teachers. Notwithstanding numerous and important minor improvements, the school system as a whole remains unchanged. Our children of seven and eight years are learning to read and write because our grandfathers were so doing at that age.

We can not here discuss the origin of our present school curriculum, but, as explaining the prominence given to reading, writing, and arithmetic, it is worthy of notice that originally the elementary

* See the article on Courses of Study in the Elementary Schools of the United States, by T. R. Crosswell, Pedagogical Seminary, April, 1897.

school existed to teach just these three subjects. The primitive schoolmaster was not superior to the parents of the child, usually not their equal, in anything except his knowledge of "letters." So the child was sent to school for a short time to learn letters. It was not at all the function of the school to *educate* the child in all that was necessary to fit him for the duties of life. Afterward, as the scope of the school was enlarged, other subjects were added, and these were put *after* the original ones, and the schoolmaster, furthermore, came rather to take the place of an educator than a mere teacher of letters. It is conceivable, therefore, that the present accepted order of studies in our elementary schools rests upon an accidental rather than upon a psychological basis. It is true that modern educators have expressly considered the subject of the order and correlation of studies, as, for instance, in the case of the Committee of Fifteen, and that, while recommending minor changes in the school curriculum, they have not usually thought of questioning the position so long held by reading, writing, and arithmetic. In the report of the committee just referred to we find this expression: "The conclusion is reached that learning to read and write should be the leading study of the pupil in his first four years of school." But, again, it was not the function of this committee to suggest sweeping changes, nor to raise the inquiry whether the system itself rests upon a psychological basis. Even if it did not rest upon such a basis, expressions like the above would not be unnatural on the part of committees appointed by bodies representing the system as a whole.

We may not, then, conclude *a priori* that our system of primary education is a sound one. There have indeed been other wholly different systems giving excellent results in their time, as, for instance, that of the ancient Greeks, where music and gymnastics, not reading, writing, and arithmetic, were the principal subjects occupying the time of the pupils.

Much attention has recently been given to the subjects of the physiology and psychology of children. These studies have been systematic, painstaking, and exact. It seems, indeed, to many people improbable that anything very new or very remarkable should just at this time be found out about children, and there have not been wanting either prominent educators or psychologists who have given public expression to warnings against the new "child study." But this, again, is not conclusive, for students of history may recall that every advance in science has met just such opposition—for instance, bacteriology, organic evolution, chemistry, and astronomy. Furthermore, when we reflect that scientific advance in this century has ever been, and inevitably, from the simple to the complex, and, further, that the brain of the child is the most complex thing in the whole range of natural history which science will ever have to attempt, it is not difficult to understand that scientific knowledge of it with its pedagogical implications has not belonged, at any rate, to the past. It will belong to the future, having, perhaps, its beginnings in the present. An educational system which has not reckoned with an accurate knowledge of the brain of the child may by accident be a correct one, but until such reckoning is made we can not be sure.

Our increasing knowledge of the child's mind, his muscular and nervous system, and his special senses, points indubitably to the conclusion that reading and writing are subjects which do not belong to the early years of school life, but to a later period, and that other subjects now studied later are better adapted to this early stage of development. What is thus indicated of reading and writing may be affirmed also of drawing and arithmetic. The reasons leading to this conclusion can be only very briefly summarized here.

As regards reading, writing, and drawing, they involve, in the first place, a high degree of motor specialization, which is not only unnatural but dangerous for young children. Studies in motor ability have shown that the order of muscular development is from the larger and coarser to the finer and more delicate muscles. The movements of the child are the large, free movements of the body, legs, and arms, such as he exhibits in spontaneous play. The movements requiring fine co-ordination, such as those of the fingers and the eyes, are the movements of maturer life. If we reverse this order and compel the child to hold his body, legs, and arms still, while he engages the delicate muscles of the eyes and fingers with minute written or printed symbols, we induce a nervous overtension, and incur the evils incident to all violation of natural order. The increasing frequency of nervous disorders among school children, particularly in the older countries, is probably due in part to these circumstances. If we consider the brain of the child of seven or eight years, our conclusions are strengthened that he should not be engaged in reading and writing. At this age the brain has attained almost its full weight, and is therefore large in proportion to the body. Its development is, however, very incomplete, particularly as regards its associative elements—that is, the so-called association fibers and apperception centers. Such a brain constantly produces and must expend a large amount of nervous energy, which can not be used centrally—that is, psychologically speaking—in comparison, analysis, thought, reflection. It must flow out through the motor channels, becoming muscular movement. The healthy child is therefore incessantly active in waking hours, the action being of the vigorous kind involving the larger members. Hence we can understand that, of all the ways in which a young child may receive instruction, the method through the printed book is pre-eminently the one ill fitted to him.

The evil of this method is aggravated by the fact that, before the child can receive instruction through the book, a long time—several years, in fact—is spent in the confining task of learning to read. It comes about, therefore, that the child, at the very age when he should be leading a free and expansive life, is obliged to fix his eyes upon the narrow page of a book and decipher small printed symbols, in themselves devoid of life and interest. With respect to writing and learning to write the case is worse. A considerable amount of motor specialization is involved in forming letters upon the blackboard, but when the pencil and pen are used it becomes of an extreme kind. In the whole life history of the man there are no movements requiring finer co-ordination than those of writing with pencil or pen, yet our school system requires these of the child of six or seven years, makes them, indeed, a prominent part of elementary school life. In addition to the motor specialization of reading and writing is the physical confinement in the narrow seat and desk which is necessarily connected with them. The child of six or seven has not reached the age when such confinement is natural or safe.

The injuries which I have mentioned relate to the nervous system as a whole. There are other injuries resulting from the reading habit in young children which concern the eyes directly. So much has been said and written lately about the increase of myopia and other defects of the eye among school children, that I shall merely refer to this subject here. Upon entering school, children are practically free from these defects. Upon leaving school, a strikingly large percentage are suffering from them, more, however, as yet, in European countries than in America. The causes are many, but it is scarcely doubted that the chief cause is found in bending over finely printed books and maps, and fine writing, pencil work, and drawing. If pencils, pens, paper, and books could be kept away from children until they are at least ten years of age, and their instruction come directly from objects and from the voice of the teacher, this evil could be greatly lessened.

If the above reasons for not teaching reading and writing to young children were the only ones, the objections could to a certain extent be overcome. Writing might, for instance, be practiced only on the blackboard with large free-hand movements, and letters could be taught from large forms upon charts. But we have to consider the questions whether reading and writing are in themselves branches of instruction which belong to the early years of school life, whether they may not be acquired at a great disadvantage at this period, and whether more time is not spent upon them than is necessary. It is a well-known fact that a child's powers, whether physical or mental, ripen in a certain rather definite order. There is, for instance, a certain time in the life of the infant when the motor mechanism of the legs ripens, before which the child can not be taught to walk, while after that time he can not be kept from walking. Again, at the age of seven, for instance, there is a mental readiness for some things and an unreadiness for others. The brain is then very impressionable and retentive, and a store of useful material, both motor and sensory, may be permanently acquired with great economy of effort. The imagination is active, and the child loves to listen to narration, whether historical or mythical, which plays without effort of his will upon his relatively small store of memory images. The powers of analysis, comparison, and abstraction are little developed, and the child has only a limited ability to detect mathematical or logical relations. The power of voluntary attention is slight, and can be exerted for only a short time. All this may be stated physiologically by saying that the brain activity is sensory and motor, but not central. The sensory and motor mechanism has ripened, but not the associative. The brain is hardly more than a receiving, recording, and reacting apparatus. It would be inaccurate, however, to express this psychologically by saying that perception, memory, and will are the mental powers that have ripened at the age of seven. This would be true only if by perception we mean not apperception, which involves a considerable development of associative readiness, but mere passive apprehension through the senses, and if by memory we mean not recollection, but mere retentiveness for that which interests, and if by will we mean not volition, but only spontaneous movement and readiness to form habits of action, including a large number of instinctive movement psychoses, such as imitation, play, and language in its spoken form.

Following out, then, somewhat as above, the psychology of the child, what kind of education would be particularly adapted to his stage of development? We ask not what *can* the child be taught, but what studies are for him most natural and therefore most economical. In the first place, from the development of the senses and the perceptive power above described, we infer that the child is ready to acquire a knowledge of the world of objects around him through the senses of sight, hearing, touch, temperature, taste, and smell. His education will have to do with real things and their qualities, rather than with symbols which stand for things. If we wish a general term for this branch of instruction, we may call it natural science, or, to distinguish it from science in its more mature form as the study of laws and causes, we may call it natural history, or, more briefly, Nature study. Although the appropriateness and economy of this study for young children has been known and proclaimed for more than a century, it is still in practice the study of later years, while young children study *letters*.

In the second place, from the development of the retentive powers of the child we infer that he is qualified to gain acquaintance not only with the real world around him, but with the real world of the past. We may call this history. History is now studied later by means of text-books. It may be studied with far greater economy during earlier years by means of direct narration by parent or teacher. It is wonderful how eagerly a child will listen to historical narration, and how easily he will retain it. This method of teaching history forms a striking contrast to the perfunctory manner in which it is often studied in the upper school grades, with the text-book "lesson," "recitation," and the "final examination." Upon the minds of many young people the study of history has a deadening effect when the history epoch is passed and the mathematical epoch has arrived. It has already been proposed, at a conference of educators lately held in Chicago, to extend the study of history downward into the lower grades, a proposition fully sanctioned by psychological pedagogy. In what I have here said about history for young people I refer not to the philosophy of history, which comes much later in the life of the student, but to history as a mere record of facts and events, the kind of history which is now studied in the grammar and high schools, the kind which many educators who would make all children philosophers are now saying should not be studied at all.

In the third place, what studies correspond to the development of the will in the child from five to ten? It is the habit-forming epoch. It is the time when a large and useful store of motor memory images may be acquired, and when permanent reflex tracts may be formed in the spinal cord and lower brain centers. This is the time to teach the child to do easily and habitually a large number of useful things. If we use the term in its broadest sense, we may call this branch of instruction morals, but it will also include, besides habits of conduct, various bodily activities, certain manual dexterities, and correct habits of speech, expression, and singing. But here some restrictions must be observed. The habit-forming period begins at birth and continues far beyond the age of ten, and the period from five to ten is not the time for the formation of all habits. The order of muscular development must be observed, and all dexterities involving finely co-ordinated movements of the fingers, or strain of the eyes, should be deferred beyond this period, or at most begun only in the latter part of it; such, for instance, as writing, drawing, modeling, sewing, knitting, playing upon musical instruments, and minute mechanical work, as well, of course, as the plaiting, pricking, stitching, weaving, and other finger work still practiced in some kindergartens and primary schools.

We have thus seen that there are certain branches of instruction for which the mind of the child from five to ten has ripened, and which may therefore be taught most economically and safely during this period. Concerning the teaching of language I shall speak presently, but thus far we have found that from the psychological standpoint there are at any rate three subjects which are strikingly adapted to this period, namely, natural science, history, and morals, using these terms with the latitude and restriction already explained. Certain branches of Nature study and one branch of what we have called morals—namely, manual training—have in recent years been introduced into our best elementary city schools, and in a few schools history is taught systematically in the lower grades by means of stories. They have not, however, crowded out reading, writing, and arithmetic so much as crowded into them. But if we consider the great mass of schools in city, town, and country throughout the land, the subjects which practically complete the elementary school curriculum—reading, writing, arithmetic, and geography—are, with the exception of the latter, found to be subjects which do not naturally belong to this period at all. Mathematics in every form is a subject conspicuously ill fitted to the child mind. It deals not with real things, but with abstractions. When referred to concrete objects, it concerns not the objects themselves, but their relations to each other. It involves comparison, analysis, abstraction. It calls for a fuller development of the association tracts and fibers of the cerebral hemispheres. The grotesque "number forms" which so many children have, and which originate in this period, are evidence of the necessity which the child feels of giving some kind of bodily shape to these abstractions which he is compelled to study. Under mathematics I do not of course include the mere mentioning or learning a number series, such as in the process called "counting," or the committing to memory of a multiplication table. Furthermore, in this and in all discussions of this kind it must be remembered that there are exceptional children in whom the mathematical faculty, or musical faculty, or literary faculty, develops much earlier than with the average child. If possible, they should have instruction suited to their peculiarities. But it is evident that, so long as children are educated in "schools," there must be a general plan of education, and that it can not be based upon exceptional children.

What we learn from physiology and psychology about the ripening of the child's mind is confirmed by the theory of the "culture epochs." I can not discuss here the doctrine of "recapitulation," with its great truths and its minor exceptions, but it is well known that in a general way the development of the child, both physical and mental, is an epitome of the development of the race. If we compare the physical and mental activities of the modern civilized man with those of the more primitive member of the race, we may learn what forms of physical and mental activity are natural in the different periods of child life. Some of the things which are characteristic of the modern as contrasted with the primitive man are sedentary habits, manual dexterities requiring finely co-ordinated movements both of the eyes and fingers, increasing devotion to written language and books as contrasted with spoken language, the lessened dependence upon the memory, the increasing subjectivity of mental life as contrasted with the purely objective life of the savage, and the increased importance of reflection, deliberation, and reasoning, with decrease of impulsive and habitual action. These things, then, we should expect to belong to the later period of child life, and studies which involve these activities will not be economically pursued in the elementary school grades. These laws are wholly overlooked in our traditional school curriculum. In practice we are saying to the young child: "Man is a sedentary, reading, writing, thinking, reasoning being, possessing the power of voluntary attention. I am to educate you to be a man. Therefore you must learn to sit still, to read, write, think, reason, and give attention to your work." The child of six or eight years is therefore given a book or pen, and put into a closely fitting seat and left to give attention to his work. This is precisely as if the mother should say to the infant at the beginning of the period of creeping: "You are a man, not a brute. Men go upright, not on all fours. You must walk, not creep."

I wish to call especial attention to the fact that it is only late in the history of the race that language has passed to its written form. Man is indeed now a reading and writing animal, but only recently has he become so. It is only since the invention of printing and the wide dissemination of books, magazines, and newspapers that reading has become a real determining factor in the life of the people. Even now the human organism is engaged in adapting itself to the new strain brought upon the eyes and fingers in reading and writing. We can understand, therefore, that it will demand a considerable maturity in the child before he is ready for that which has developed so late in the history of the race. The language of the child, like that of the primitive man, is the language of the ear and tongue. The child is a talking and hearing animal. He is ear-minded. There has been in the history of civilization a steady development toward the preponderating use of the higher senses, culminating with the eye. The average adult civilized man is now strongly eye-minded, but it is necessary to go back only to the time of the ancient Greeks to find a decided relative ear-mindedness. Few laboratory researches have been made upon the relative rapidity of development of the special senses in children, but such as have been made tend to confirm the indications of the "culture epochs" theory, and to show that the auditory centers develop earlier than the visual.

More and more attention is given in our elementary schools to the subject of language—more, as some think, than the relative importance of the subject warrants; but without discussing this question, it is indubitably shown by child psychology that it is the spoken language which belongs to the elementary school. The ear is the natural medium of instruction for young children, and all the second-hand knowledge which it is necessary that the child should receive should come to him in this way. It should come from the living words of the living teacher or parent, not through the cold medium of the printed book. In the elementary school, then, the child may be instructed in language as it relates to the ear and the tongue, and this is the real language. He may be taught to speak accurately and elegantly, and he may be taught to listen and remember. He may study in this way the best literature of his mother tongue, and get a living sympathetic knowledge of it, such as can never come through the indirect medium of the book. Indeed, this language study need not be limited to the mother tongue. There is no age when a child may with so great economy of effort gain a lasting knowledge of a foreign language as when he is from seven to eleven years old.

When the spoken language has been mastered in this way, and when the child has arrived at the reading and writing age, language in its written form may be acquired in a very short time, and that which now fills so many weary years of school life will sink into the position of comparative insignificance in which it rightfully belongs. Reading and writing have usurped altogether too much time. In the schools of to-day there is a worship of the reading book, spelling book, copy book, and dictionary not rightfully due them. By dropping the study of letters from the lower grades much needed time may be found for other timely and important subjects, such as Nature study, morals, history, oral language, singing, physical training, and play.

One of the greatest goods which would follow the banishing of the book from the primary and elementary schools would be the cultivation of better mental habits. Children suffer lasting injury by being left with a book in their seats and directed to "study" at an age when the power of voluntary attention has not developed. They then acquire habits of listlessness and mind-wandering afterward difficult to overcome. They read over many times that which does not hold their attention and is not remembered. Lax habits of study are thus acquired, with the serious incidental result of weakening the retentive power which depends so much upon interest and concentration. With the substitution of the oral for the book method, reliance upon the memory during the memory period will permanently strengthen the child's power of retention.

The period between the ages of five and ten years is an important one in the child's life. It is the time when the "let-alone" plan of education is of most value, for the reason that nearly all our educational devices beyond the kindergarten are more or less attempts to make men and women out of children. If the child at this age must be put into the harness of an educational system, his course of study will not be impoverished by the omission of reading and writing. To teach him to speak and to listen, to observe and to remember, to know something of the world around him, and instinctively to do the right thing, will furnish more than enough material for the most ambitious elementary school curriculum.

SOILS AND FERTILIZERS.*

By CHARLES MINOR BLACKFORD, Jr., M. D.

THE word "soil" is used in several arts and sciences to denote the material from which something derives nourishment. The meat broths and jellies on which bacteria are grown are soils for them, as the earth of a field is a soil for the ordinary farm crops; but in general we mean by soils the various mixtures of mineral and organic substances that make up the surface of the earth.

The object of this paper is to show as briefly as possible the way it was formed, of what it is composed, the manner in which it nourishes plants, and the rules that should guide us in replenishing its nutritious matter when exhausted. So broad a field can be but lightly touched, and the effort will be to give only hints from which rules for specific cases may be deduced.

When a sample of ordinary fertile soil is analyzed, it is found to consist of a number of minerals, of carbon, nitrogen, and phosphorus in various combinations, water, and certain other ingredients dependent on the locality. Among the minerals the most important are potassium, sodium, lime, iron, and silicon, and the history of these is of the greatest interest.

Scientific students are generally agreed that the surface of the earth is but a shell inclosing a liquid, or at all events a highly heated

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interior. Originally the whole mass was fluid, but the surface has cooled more rapidly than the interior, and so a firm crust has been formed. As the central mass cooled, it contracted, and the crust became wrinkled and folded, as does the skin of an apple as its pulp dries, and, by this folding, great ridges were thrown up in some places and vast depressions formed in others. When the crust became cool enough for water to remain on it, most of the depressions were filled by it, and the "dry land appeared," not only on the crests of the ridges, but on the elevated plateaus about them, and thus oceans and continents were formed.

Had one of us seen the earth at that time he would have been loath to select it as a residence. Rugged, rocky ranges of precipitous mountains surrounded by stretches of naked rock made the landscape. Dense clouds from the tepid oceans dashed against the icy peaks, and torrents of water rushed back to the sea. Where the slopes permitted, the glaciers spread over wide areas, for no vegetation checked the rapid radiation of heat, and night brought bitter cold. The crust waved and fluctuated over the liquid interior as does thin ice under a daring skater, and as it fell the sea rushed over the land, only to flow elsewhere as the depressed area rose again. The freezing and thawing and the effects of wind and water in time produced a change. The rocks were riven and broken to powder, their nearly vertical slopes became less steep, and instead of bare rock the earth showed dreary morasses and stretches of sand.

Over these marshes vegetation began to thrive. In the sea there lived then, as now, a teeming population, animal, vegetable, and living beings that can with difficulty be assigned to either of these classes. Each of them, however, contained carbon, and many had built lime, phosphorus, nitrogen, and other valuable substances into their bodies. Where food was abundant these grew in vast numbers, and though many are infinitely small singly, their aggregate mass is enormous. Among the tiny organisms is one called the *Globigerina*, a being so small as to require a microscope to study it, but in the past, as now, growing in great numbers in the sea. The animal is soft and jellylike, but it forms an outside skeleton of shell of carbonate of calcium or chalk, a structure that protects it living, but entombs it dead. When death comes, the little *Globigerina* sinks to the bottom, and its tiny shell helps to cover the sea floor.

In the days of long ago these lived as now, and when some convulsion of Nature lifted the bottom of prehistoric seas, the *Globigerina* ooze was lifted as well, and thus the "limestone" formed. In our land a bed of this kind extends from Alabama to Newfoundland; thence, as the "telegraphic plateau," it passes under the Atlantic, rising into the chalk downs and cliffs of England; then, again dipping under the sea, it passes through Europe, and finally furnishes the marble quarries of Greece. Heat, water, and chemical action give a ceaseless variety to the forms of the limestone, but wherever found it shows the former seat of an ocean.

As soon as the "ooze" was lifted from below the sea it began to change. Some has been exposed to heat and has crystallized into marble, but for our purposes the most interesting changes have been wrought by water. Chalk, limestone, and marble—for these are chemically the same—are almost insoluble in pure water. But water is rarely pure; it dissolves many things, and among them the carbonic-oxide gas that every fire, every animal, every decaying scrap of wood is pouring into the atmosphere. The rain, charged with this gas, dissolves the limestone, but when the gas escapes the lime falls, as you know happens when "hard" water is boiled, for the heat drives off the gas. By this solution, however, the lime is scattered widely through the soil, and is rarely lacking in untilled earth.

Besides lime, phosphorus is necessary in a good soil. This is widely spread in Nature, but its great reservoir is the ocean, that boundless mine of wealth. Many marine animals have the power of building it into their tissues, and the shells of oysters and other mollusks, the bones of nearly all animals, terrestrial and marine, and parts of other organisms, are composed of phosphates to a greater or less degree. In the ceaseless changes of level the primal oyster beds and coral reefs are raised to the surface or far above it, and the slow action of time begins to tear down the deposits and spread them widecast. Since that far-off time "in the beginning" no new matter has been put on earth save the small amounts of the meteorites, and the economy of Nature can allow not one atom to lie in idleness, but calls on each one to play its part ceaselessly, "without haste and without rest." A certain amount of a substance is disseminated through the earth; by rains it is washed into the streams, and thence to the sea. Here plants or animals eagerly await it, and by means of them it is again restored to the land, to begin again its endless round.

The metals most necessary for plant life are potassium, sodium, and iron; indeed, the very name of the first shows its importance. If the ashes which contain all the mineral constituents of plants be put in a vessel and water poured on them, a solution of lye will percolate through the mass. The word lye is an abbreviation for alkali, and when chemistry became sufficiently advanced, a metal was discovered in this lye to which the name potassium—i. e., potash-metal—was given. If seaweeds be burned and leeched in the same way we can obtain from the lye another metal, sodium, that is much like potassium, and that is one of the most widely spread substances on earth as its chloride, or common salt.

Potassium and sodium enter into the composition of many rocks, and as these become eroded by weather they are scattered through the soil, whence their salts are extracted by rootlets and enter into the formation of vegetable tissue.

Behind these stands iron. The green coloring matter of plants is a very complex substance known as chlorophyll, the duty of which is to take carbonic oxide from the air, utilize the carbon, and restore the oxygen. Iron enters into the composition of chlorophyll, and to it is due the brown color of dead leaves. This metal is well-nigh universal, all the reds and browns in soils and rocks being made by it, and so it is rarely lacking anywhere.

So much for the metals in soils; but, important as they are, plants can not live on them alone. Among the nonmetallic bodies phosphorus stands high among essentials, and for it we are indebted to the sea and the interior of the earth. Many living creatures extract phosphorus from the sea water—combine it chiefly with lime, and use the phosphate for making skeletons or shells, as the case may be. After the death of the possessors the bones or shells sink to the bottom, as do the *Globigerina*, and in time are either lifted up, as were the limestones, and form "phosphate beds" like those of Georgia and Florida, or are dredged up and ground into powder with bones of land animals.

Much of the matter forced up from the interior of the earth contains phosphorus; indeed, it is the bane of Southern iron ores; but though iron masters dread it, farmers welcome it, as the rains and frosts crumble the phosphatic rocks and add them to the mass of *débris* that forms our soil.

Now let us take a test tube and put into it lime, potash, soda, iron, silicon, or sand, and phosphorus, add to it a grain of corn, and watch results. Under suitable conditions of warmth and moisture the grain will sprout, but when the store of food laid up in it is exhausted our little plant will die. It is obvious that something else is needed for a soil, and analysis shows that it is nitrogen, the gas that forms nearly four fifths of our atmosphere—a gas useless, as such, to animals, but essential to plants. Nitrogen is abundant in Nature. Besides being nearly four fifths of the air, it forms twenty-two per cent of nitric acid, forty-five per cent of saltpeter or niter, eighty-two per cent of ammonia, and about twenty-five per cent of sal ammoniac. Plants can not use nitrogen in its pure form, but one or another of these forms will be found in the soil, whence it may be extracted.

Now we have the chief articles of plant food, and it is necessary to know how they are to be used. A plant usually consists of two parts, one that appears above ground, bearing branches, twigs, and leaves, and another that remains below ground. It is this latter that concerns us now, and it is worth study. This lower part consists of a number of twigs called rhizomes, from which proceed a vast number of fine, threadlike rootlets, and these are the mouths of the plant, through which it draws nourishment from the earth about it.

Before any living thing can use nourishment from without, it must be dissolved, and this solution requires much preparation at times. Men, and other animals with a wide range of food stuffs, effect this by the secretions of the digestive organs; but most plants have no digestive apparatus, strictly speaking, and were they supplied with an abundance of the foods they most need, they would starve unless the food were in a suitable state for absorption.

The way in which Nature effects this solution is the key to many of her secrets, and it has been understood only within the past few years. If we have a piece of meat freshly taken from an animal we find it firm, coherent, and almost odorless. If it be put into a warm, moist chamber for a few days a great change comes over it, and it becomes soft, offensive in odor, and liable to fall to pieces. We say that it is rotten or putrid. If a bit of it be put under a microscope, it is seen to be teeming with bacteria, and these are responsible for the decay. Now, if a specimen of earth be examined, we find that it contains bacteria, that attack all kinds of organic matter, tearing it to pieces to get their food, and making many different things out of what is left. There is one sort of ferment that grows in apple juice and splits the sugar into alcohol and carbonic acid, forming "hard cider," and if the fermentation stops at this point the well-known drink results. However, there is another ferment called "mother of vinegar" that may get in, and, if so, a different kind of fermentation is started that forms acetic acid instead of alcohol; or the bacteria of decomposition may come in and the whole go back to its elements.

There is a wonderful provision of Nature shown in these stages. The bacteria—the organisms that produce decay—can not live in a strong sugar solution, but the ferments, like common yeast, can live in it, and they split the sugar into alcohol, carbonic oxide, and other things. In these another set can live, and when the first have died of starvation or from the alcohol they form, the second set step in and turn the weak alcohol into acetic acid. Acetic acid is a preserving agent, as our sour pickles show, but if it is not too strong there are some organisms that can live in it, and the whole process ends in decay. Now, it should be noticed that each of these organisms paves the way for the next by converting an unsuitable food stuff into a suitable one.

This familiar example indicates the lines on which Nature works. It is the same everywhere, and shows the advantage of specialization, of allowing some one with peculiar facilities for performing an act to do that exclusively, that others may profit by his skill. So long as each man sought and killed his food, cooked his meals, made his own clothing, weapons, and implements—in a word, lived alone—advance was impossible. It was only when he who was most skillful with the needle made garments for the hunter in exchange for a haunch of venison, that the hunter could practice marksmanship, and the tailor design a new cut for the mantle with which the warrior might dazzle the daughter of the arrow maker. It is the same in Nature. Some organisms possess powers of elaborating certain materials of which others are quick to avail themselves. Plants can manufacture starch, an article needed by animals, but of which their own capacity, so far as producing it is concerned, is very limited, and thus animals find it advantageous to avail themselves of these stores instead of taxing their own resources. Similarly, plants need the organic matters of the animal bodies, and wise agriculture supplies carbon, nitrogen, and other articles of food in the shape of animal and vegetable refuse. But this matter requires digestion; it must be made soluble before it can be absorbed, and but few plants can effect this solution unaided. The "Venus's flytrap," the sundew, the wonderful "carrion plant," and others, are equipped with elaborate apparatus by which they are enabled to capture, kill, and literally digest the insects that supply them with nitrogeneous food, but these are exceptional cases. Nature usually employs other agents.

The action of bacteria in causing decay has been said to be in general similar to fermentation—that it is effected by the bacteria in seeking their food. If oxygen be abundant, putrefaction occurs; if it be scant or absent, then fermentation takes place, for the tiny organisms require oxygen, and, if the air fails them, they pull to pieces the organic matters near them to obtain it. In doing this they get the nitrogen into such shape that the plants can use it, and thus digest their food for them. All organic matter contains carbon, hydrogen, and oxygen as a general rule, and to these are often united phosphorus, sulphur, nitrogen, and others, making very complex arrangements, veritable houses of cards, in fact, only held together by the strange power of life. When a leaf falls or a bird dies, some of these combinations are broken, and then the bacteria and other lowly organisms have full sway, for living matter is impregnable to all save a few of them. As oxygen or something else is taken out of the complex molecules, the compound falls to pieces, but as in the kaleidoscope the bits of colored glass tumble into endless varieties of symmetrical figures, so do the atoms fall into new combinations. If the keystone of an arch be removed, the stones fall apart; but atoms, unlike bricks or stones, can not stand alone as a rule;

they must be united to something, and so, as soon as old associations are dissolved, new ones are formed. These new ones are those needed by plants, and thus is plant food digested.

The term "plant food" has been frequently used, and should now be distinctly explained, for merely stating the chemical elements is not describing the food. When a physician tells a nurse to feed a patient he does not order so much carbon, nitrogen, phosphorus, and the like, but specifies a soup, certain vegetables, and so on, detailing every particular; and the same should be done for vegetable invalids.

In medical practice a condition is recognized that is called scurvy. It is not exactly starvation, but is produced by lack of some food materials usually supplied by fresh vegetables. If scurvy appears at sea, no amount of meat, bread, cakes, or pastry will stop it; vegetables, and they only, will stay it. Sometimes a similar condition prevails among crops: some ingredient in a soil is lacking, and the others may be supplied indefinitely without giving the desired relief. To this may be attributed much of the fault found with fertilizers; for if the soil does not need a particular compound it is useless to apply it, and an excellent fertilizer is often blamed for not producing a crop on land already overstocked with it and crying for something else.

Let us suppose a field on which cotton has been grown for many successive years until it has become exhausted. Analysis shows that a crop yielding one hundred pounds of lint to the acre removes from the soil:

Nitrogen	20.71	pounds;
Phosphoric acid	8.17	"
Potash	13.06	"
Lime	12.60	"
Magnesia	4.75	"
Total	59.29	"

The weight of the whole crop from which these figures were taken was eight hundred and forty-seven pounds, so that cotton exhausts land less than any staple crop, if the roots, stems, leaves, etc., be turned under and only the lint and seed be removed. Of these the lint (one hundred pounds) takes 1.17 pound from the soil, and the seed 13.89 pounds, making 15.06 pounds net loss.* But ignoring returns that may be made in the shape of cotton-seed meal, etc., and lime, with which our soils are abundantly supplied, we see that nitrogen, phosphoric acid, and potash have been removed. Suppose the owner puts bone meal on his exhausted land: the phosphoric acid in the bone will supply one need, and an improvement results. On the strength of this, bone meal will be loaded into the soil again,

* United States Department of Agriculture. Farmers' Bulletin, No. 48.

and let us suppose the deficit not yet made up, the crop again shows improvement. Now, phosphoric acid abounds in the soil, though the deficiency in nitrogen and potash has become steadily greater; so, when the customary bone meal is applied, the crop falls back, because the plants are starving for potash and nitrogen. They are like scurvy-smitten sailors, but many thoughtless farmers would attribute the decline to the maker of the bone meal, and say that its quality was not so high as formerly—an opinion similar to that of a sea captain who would ascribe to the poor quality of salt beef an outbreak of scurvy on his vessel.

As crops of any description extract potash, nitrogen, and phosphoric acid from soils, the question how they are to be replaced is an important matter, and its answer may be most readily found by studying Nature's methods. In parts of the Old World there are fields that are fertile in the extreme after thousands of years of tillage, and it is apparent that mere cultivation does not prove injurious. The tropical forests have something growing wherever a plant can find foothold—a population in which the struggle for food is secondary to that for light and air, and yet the soil supporting this vegetation is marvelously rich. Every leaf that falls remains where it fell until in the warm, moist, half-lighted forest it becomes a little heap of mold. The bacteria of decomposition require warmth and moisture for their life; light is deleterious to them, but they thrive in the dense shade of the jungle. The tangled web of roots, weeds, and vines retains the rainfall, retarding evaporation, and preventing both droughts and freshets. Receiving dead and broken leaves, boughs, and other vegetable products, and spared the washing of violent torrents, the forest is inestimably fertile.

On a smaller scale this goes on universally. The annual weeds, deciduous leaves, and such matter, fall prey to molds and bacteria, by which they are made soluble. Snows and rains bear the products into the soil, and there other bacteria, clustering around the roots, form the acids needed to complete solution. Every one knows that "well-rotted" manure is better than that which is fresh, and many wonder at this, but the reason is apparent. In feeding delicate patients, physicians often prescribe predigested foods or the digestive ferments to aid enfeebled assimilation; and similarly the manures that have been thoroughly acted on by bacteria, or containing those capable of producing the matters that plants need, are of most value for nourishing vegetation.

In producing an article of any sort, the cheapness and ease with which it can be made is largely dependent on the shape in which the raw material reaches the factory. If a foundry can procure iron that needs only to be melted and cast, the owner can fill his orders more readily than would be possible if he had to reduce the metal from the ore; and Nature uses this principle over and over again. The importance of nitrogen to plants and its abundance in Nature have been mentioned, but it has also been said that plants can not use it directly, as most animals do with oxygen. The tiny bacteria intervene, and this they do in two ways: first, by causing decay of animal or vegetable matter containing nitrogen, and by this decay producing substances that plants can absorb; and, secondly, by producing little nodules or "tubercles" on the rootlets, through which the plant can take up nitrogen.* Now, when a plant is sated with nitrogen, it ceases to form these tubercles, and their formation is a sure sign that the plant is craving this article of food. When it is supplied, and its own life is ended, these form reservoirs from which other plants may be supplied, as new castings may be made from broken wheels. The great value of "green manuring" depends on the store of available nitrogen so laid up, but it is open to failure in one direction. The liability of fermentation to go to the acid stage from contamination with acid-forming ferments has been mentioned, an accident the possibility of which is impressed on us from time to time by sour bread; and similarly the organic matter turned under may undergo acid fermentation, rendering the ground "sour" and unfit for cultivation.

The limits of this paper forbid the consideration of special fertilizers, but from the general principles laid down the rules for any special case may be deduced. A soil should contain a sufficient amount of potash, soda, lime, iron, and a few other minerals; phosphoric acid, nitrogen, organic matter, and, for some special crops, some other ingredients may be needed. When the soil needs renewing, there are two ways of accomplishing it. One way is to guess at what is needed; to buy fertilizers at high prices, without inquiring whether the soil needs the substances in that particular brand or not. Though very common, this is not a good plan. It is as though a physician were to give a patient any drug that was convenient, without inquiring into the disorder or the needs of the system, and it is followed by much the same result. That acid phosphate gave Farmer A a good crop, is no reason that Farmer B's land is also deficient in phosphorus. The same reasoning would teach that a heart stimulant that rouses a patient from shock would benefit one in danger of apoplexy, where the least increase in heart force might be fatal. A physician using such reasoning as the basis of his practice would not be considered a master of his art; and were he to attribute the fatal outcome of his logic to the poor quality of his stimulant, he would display criminal ignorance of drugs as well as disease; yet it

* Leguminous Plants for Green Manuring and for Feeding. E. W. Allen, Ph. D. United States Department of Agriculture. Farmers' Bulletin, No. 16.

is very common to see farmers put guano on a soil begging for potash, and then heap execration on the head of the dealer who sold the guano when the crop failed. To revert to a simile used above, a captain must not blame the salt pork for scurvy.

The other way to buy and use fertilizers is to ascertain what a certain crop needs; then find out whether these be in the soil, and to what extent. With these data the deficiency may be made good without the wasteful cost of the former method. State and Federal Departments of Agriculture furnish their aid freely and gladly, and already the signs are seen of the day when agriculture will take its place among the semiexact sciences, and the present haphazard methods will become obsolete.

SKETCH OF AUGUST KEKULÉ.

"THIS news," said Herr H. Landrelt, president, announcing Kekulé's death in the German Chemical Society at Berlin, "will be received with sorrow not only by our society but by the whole chemical world. Science has again lost one of its greatest representatives, one of those extremely rare spirits who were called upon to found a new epoch in it and push it mightily forward."

Friedrich August Kekulé was born at Darmstadt, September 7, 1829, and died, after a long illness, at Bonn, July 13, 1896. He was originally destined by his father for the profession of an architect; and some houses, he told his students in a festival address, still existed (in 1892) in Darmstadt of which he drew the plans when, a youth, he was attending the gymnasium. The leading events of his life were very tersely told by himself in an address responding to an ovation from the students of the University of Bonn on the twenty-fifth anniversary of his professorship there; a translation of which, from the *Kölnische Zeitung*, was published by Mr. J. E. Martin in Nature, June 30, 1892.

At Giessen, he said, where he went to study architecture, he attended Liebig's lectures, and was thereby attracted to chemistry. But his relatives would not at first hear of his changing his profession, and he was given a half-year's grace to think over it. He spent his time in the Polytechnicum at Darmstadt. His first teacher in chemistry at Darmstadt was Moldenhauer, the inventor of lucifer matches. His leisure time was spent in modeling in plaster and at the lathe. He was then permitted to return to Giessen. "I attended," he said, "the lectures, first of Will and then of Liebig. Liebig was at work on a new edition of his letters on Chemistry, for which many experiments had to be carried out. I had to make estimations of ash, of albumen, to investigate gluten in plants, etc. The names of the young chemists who helped Liebig were mentioned in the book, among them mine. The proposal was then made to me, just at the time Liebig intended to make me his assistant, that I should go for a year abroad, either to Berlin, which was at that time to Giessen a foreign land, or to Paris. 'Go,' said Liebig, 'to Paris; there your views will be widened; you will learn a new language; you will get acquainted with the life of a great city; but you will not learn chemistry there.' In that, however, Liebig was wrong. I attended lectures by Frémy, Wurtz, Pouillet, Regnault; by Marchandis on physiology, and by Payen on technology. One day, as I was sauntering along the streets, my eyes encountered a large poster with the words *Leçons de philosophie chimique par Charles Gerhardt, ex-professeur de Montpellier.* Gerhardt had resigned his professorship at Montpellier, and was teaching philosophy and chemistry as *privat docent* in Paris. That attracted me, and I entered my name on the list. Some days later I received a card from Gerhardt; he had seen my name in Liebig's Letters on Chemistry. On my calling upon him he received me with great kindness, and made me the offer, which I could not accept, that I should become his assistant. My visit took place at noon, and I did not leave his house till midnight, after a long talk on chemistry. These discussions continued between us at least twice a week for over a year. Then I received the offer of the post of assistant to von Plauter, at the Castle of Reichenau, near Chur, which I accepted, contrary to Liebig's wish, who recommended me as assistant to Fehling, at Stuttgart. So I went to Switzerland, where I had leisure to digest what I had learned in Paris during my intercourse with Gerhardt. Then I received an invitation from Stenhouse, in London, to become his assistant, an invitation I was loath to accept, since I regarded him, if I may be allowed the expression, as a *Schmierchemiker.* By chance, however, Bunsen came to Chur on a visit to his brother-in-law, at whose house I first met him. I consulted Bunsen as to Stenhouse's offer, and he advised me by all means to accept it. I should learn a new language, but I should not learn chemistry. So I came to London, where as Stenhouse's assistant I did not learn much. By means of a friend, however, I became acquainted with Williamson. The latter had just published his ether theory, and was at work on the polybasic acids (in particular on the action of PCl_5 on H_2SO_4). Chemistry was at one of its turning points. The theory of polybasic radicals was being evolved. With Williamson was also associated Odling. Williamson insisted on plain, simple formulæ, without commas, without the buckles of Kolbe or the brackets of Gerhardt. It was a capital school to encourage independent thought. The wish was expressed that I should stay in England and become a technologist, but I was too much attached to home. I wished to teach in a German university. But where? In order to get acquainted with the circumstances at several universities, I became a traveling student. In this capacity I came, among other universities, to Bonn. Here there was no chemist of eminence, and hence there were no prospects. Nowhere did there seem so much promise and so great a future as at Heidelberg. I could ask no help of Bunsen. 'I can do nothing for you,' he said, 'at least not openly. I will not stand in your way, but more I can not promise.' I fitted up a small private laboratory in the principal street of Heidelberg at the house of a corn merchant—Gross, by name—a single room with an adjoining kitchen. I took a few pupils, among whom was Baeyer. In our little kitchen I finished my work on fulminate of silver, while Baeyer carried out the researches, which subsequently became famous, on cacodyl. That the walls were coated thick with arsenious acid, and that silver fulminate is explosive, we took no thought about. After two years and a half I received a call to Ghent as ordinary professor. There I stayed nine years, and had to lecture in French. With me to Ghent came Baeyer. Through the kindness of the then Prime Minister of Belgium, Rogier, I obtained the means to establish a small laboratory. I had there with me a number of students, among whom I may name Baeyer, Hübner, Ladenburg, Wichelhaus, Linnemann, Radzizewski. There was not so much a systematic course of instruction as a free and pleasant academic intercourse. After nine years' work I received the call to Bonn." Professor Kekulé concluded his address with some account of his work at Bonn, and of the great attention he had always received from his pupils. For a full account of Kekulé's scientific career and achievements, we are indebted to the memorial address made by President Landelt to the German Chemical Society on the occasion of his death, of which we translate the more important passages from the *Berichte:*

"The works which Kekulé has left behind him belong, as we all know, to the bases of all chemistry. His teachings have so passed into our flesh and blood that it seems almost superfluous to remind a circle of professional chemists of them. I shall be able to present only in the most general outlines this evening the immense influence which the dead master has exercised upon science; a complete view of all his labors is a subject for a biography, which we must wait for.

"Kekulé's scientific work began in 1854, with the discovery of thiacetic acid, by which he at once separated from the old school of chemistry that was still prevailing, and, founding a new one, revealed himself as an adherent of the new doctrine of types. After his habilitation at Heidelberg, which followed in 1856, came the essay on fulminating mercury, in which the view so important for the future was expressed, that to the three typical combinations of chlorhydrogen, water, and ammonia, hitherto recognized, might be added a fourth, marsh gas. In the next essay, on binary combinations and the theory of polyatomic radicals, he put forward the conception of mixed types, and first reached the knowledge of various atomicity or valency of the radicals. These researches were continued, and there appeared shortly afterward, in the spring of 1858, the two great treatises which have since exercised so powerful an influence on chemistry—that on the constitution and metamorphoses of chemical combinations, and that on the chemical nature of carbon. In these theses Kekulé passed from the valency of the radicals to that of the elements themselves, and showed that the composition of all those compounds that contain one atom of carbon lead to the conclusion that that element is quadrivalent; and that, further, the relations of combination of a complex of carbon atoms are explainable if we suppose that the latter are mutually bound by a certain number of their four unities of attraction. This idea was suggested very carefully, and the words which the author added at the end of his essay read very curiously to-day: 'Finally, I think I ought still to insist that I attach only little value to speculations of this sort. Since one delving in chemistry must once in a while, in the lack of exact scientific principles, content himself with probabilities and temporary hypotheses, it seems proper to communicate these conceptions, because, as it appears to me, they furnish a simple and fairly general expression for the newest discoveries, and because, therefore, the use of them may assist in the discovery of new facts.' How diffident the words sound, and how far have the expectations been exceeded! We all know that the theory of valency is to-day the leading guide through all our science; and, although another investigator had a share in its origination, no one disputes that its main foundation and its eminent value in organic chemistry are primarily due to Kekulé's idea of the quadrivalency of carbon.

"After he was called to the University of Ghent, in 1858, Kekulé exhibited an indefatigable activity. He began the great series of investigations of the organic acids which, beginning with succinic acid, malic acid, and tartaric acid, and extending afterward to many others, have given complete conclusions as to the nature of these bodies. Contemporaneously, in 1860, appeared the first number of the *Lehrbuch der organischen Chemie*, which was soon followed by other numbers, so that the whole first volume was completed in 1861. All his fellow-chemists who are acquainted with the events of that period will remember the enthusiasm with which the work was received. For the first time, in place of the former system of organic chemistry based on the old radicals of Berzelius, a system of treatment appeared which in the dress of the theory of types had the doctrine of valency as its foundation, and exposed the construction as well as the isomeric relations of the numerous carbon compounds with wonderful clearness. The work, the first two published volumes of which contained the substances designated by Kekulé as the fatty compounds, is still recognized as the prototype of many text-books that followed it.

"In 1855 Kekulé put forth the second of his great theories. First in the Bulletin of the Chemical Society of Paris, and afterward in fuller form in Liebig's *Annalen*, appeared the essay, Researches among the Aromatic Compounds, in which he showed that the substances so designated all contain six or more atoms of carbon, and that they could be described as derivatives of the simplest of them, benzene. He proposed two hypotheses to explain the constitution of this substance, one of which, the only one afterward pursued, supposed that the six carbon atoms are associated in a ring, and alternately linked by one and two valencies. By replacing the hydrogen atoms corresponding to each carbon atom by other elements or radicals one could arrive at the knowledge of the constitution of a large number of aromatic bodies which now figure as benzol derivatives. These considerations led, however, to another question—namely, whether or not the supplied places of the six hydrogen atoms are chemically equivalent. The question of space relations in chemistry first came up in connection with this investigation, and Kekulé at once endeavored to solve it. All these ideas were, however, expressed at first with reserve, and this essay closes with the words, 'I place no more value on these views than they are worth, and I believe that much labor must still be applied before such speculations can be regarded as anything else than more or less elegant hypotheses; but I believe, too, that at least experimental speculations of this kind must be used in chemistry.'

"In this case, again, Kekulé's modest expectations have been surpassed. The wonderful results that have accrued from the benzol theory are patent to all of us. We know that it was the instigation to the carrying out of an innumerable multitude of researches which are still pursued with undiminished industry. Rarely has a thought exercised so fructifying and forwarding an influence on chemistry, and so redounded to the advantage of both pure science and art. Thankfulness for this gift, as you know, prompted our society to honor the author of the benzol theory and the twenty-fifth year of the announcement of it by a public festival; and the Kekulé celebration, which took place in this house on the 11th of March, 1890, is memorable to all for the brilliant and witty speech with which the master responded to the many addresses made to him. It is preserved in our reports (*Berichte* 23, 1892), and the repeated reading of it always affords rich enjoyment."

Kekulé assumed his last position, as professor at the University of Bonn, in the fall of 1867. He there devoted his attention for a period to the erection of a new institute building, but it was not long before numerous works began again to appear—some of them by himself alone, like the important investigation of the condensation products of aldehyde; and others in co-operation with his many students. The continuation of his *Lehrbuch* was taken in hand at the same time. In 1867 he gratified his fellow-chemists by the publication of the first volume of his Chemistry of the Benzol Derivatives. This was followed from 1880 to 1887 by single numbers, prepared with the help of co-workers, of the second and third volumes.

Prof. F. R. Japp, in the Kekulé memorial lecture before the Chemical Society of London, speaking of Kekulé's residence in that city, September, 1897, said that he always acknowledged the influence which Liebig and Odling and Williamson, with whom he became acquainted in London, exercised on the formation of his opinions. Kekulé's theories, Professor Japp said, were based on Gerhardt's type theory; on Williamson's theory of polyvalent radicals, which by their power of linking together other radicals render possible the existence of multiple types; and Odling's theory of mixed types, which was a deduction from Williamson's theory. Less consciously, perhaps, his opinions were influenced by E. Frankland's theory of the valency of elementary atoms, and by Kolbe's speculation on the constitution of organic compounds. Kekulé gathered together the various ideas which he found scattered throughout the writings of his predecessors, added to them, and welded the whole into the consistent system which forms our present theory of chemical structure. In 1857, in the course of a memoir on the constitution of fulminic acid, he gave a tabular arrangement of compounds formulated on the type of marsh gas, this being the earliest statement, though put forward only in an imperfect form, of the tetravalency of carbon. In the same year he published an important theoretical paper On the So-called Conjugated Compounds and the Theory of Polyatomic Radicals, which contains a complete system of multiple types and mixed types. In 1858 the celebrated paper, On the Constitution and Metamorphoses of Chemical Compounds, and on the Chemical Nature of Carbon, appeared. It embodies the fully developed doctrine of the tetravalency of carbon, together with

Kekulé's views on the linking of atoms and on the valency of such chains of atoms, the foundation on which our modern system of constitutional chemistry rests. In 1865 Kekulé put forward his well-known benzene theory—pronounced by Professor Japp the crowning achievement, in his hands, of the doctrine of the linking of atoms, and the most brilliant piece of scientific prediction to be found in the whole range of organic chemistry. The conception of closed chains, or cycloids, which he thus introduced, has shown itself to be capable of boundless expansion.

Kekulé's students all speak admiringly of his qualities as a teacher. The memorialist of the German Chemical Society said: "All of us who have attended his lectures or heard him in other places will ever remember what a teacher Kekulé was. With incomparable lucidity and sometimes with the happiest humor, he could go playfully through the theme he was considering, masterfully presenting it in new and often surprising aspects. The charm of his personality affected all who came in contact with him; it was the geniality which shone out of his whole being, and involuntarily commanded admiration. Numerous pupils flocked to him, and many of those who to-day fill chairs of chemistry in Germany and other countries have made his name highly honored."

Professor Thorpe, of London, who spent a little time in Kekulé's laboratory, describes him as having been one of the very best expositors, with the single possible exception of Kirchhoff, to whom it had been his lot to listen. As a laboratory teacher he was excellent. He was a most severe judge of work, striving to exact the same high manipulative finish, the same neatness and order, which he invariably bestowed on everything he did, and he was absolutely intolerant of anything slovenly or "sloppy." "But it was as a lecturer that he was seen at his best. He was singularly luminous as a thinker, a close and accurate reasoner, with a remarkable power of concentrated expression. . . . His language was apt and well chosen, and his delivery easy and natural"; and his whole address showed that every detail had been carefully considered.

At a distance of thirty years, Professor Dewar said, at the London memorial meeting, that to look back and call to mind the presence and personality of the great chemist as he knew him was indeed a pleasure. He was a man of noble mien, handsome, dignified, and yet of a homely and kindly disposition. He was a severe critic, having a haughty contempt for the accidental and bizarre in scientific work. His originality and suggestiveness seemed endless, so that he had no need to commit trespass or to follow just in the wake of other people's ideas. "Everything that passed through the Kekulé alembic was indeed transmuted into pure gold. His precision of thought and diction rendered his papers profoundly suggestive to other workers."

"The last years of the master's life," his German eulogist says, "were often troubled by illness, but there were not wanting bright days which the love of his students and colleagues prepared for him." Such a one was the celebration of the twenty-fifth anniversary of his professorship at Bonn, June 1, 1892, in which the students and officers participated with cordial unanimity. The ceremony began in the morning with an enthusiastic ovation by the students. The chemical theater was decorated with plants; the benzene hexagon was figured on the blackboard with garlands of flowers, in the midst of which the letters A. K. were wrought in a monogram of roses. Alfred Helle, one of the chemical students, delivered a felicitous address, in which he congratulated his fellow-students on being privileged to sit at the feet of the greatest of living chemists, after which three cheers were given to the professor. Kekulé responded to the offering in an address giving some of the details of his life, from which we have already quoted. Kekulé's personal staff and the officers of the university then presented their congratulations.

In the evening the students honored him with a torchlight procession, it being the third time he had received this, the most conspicuous honor which is bestowed by German students. The first occasion was in 1875, when he declined the professorship at Munich; the second was in 1878, when he was rector of the university, and was given in celebration of the restoration of unity among the students, after a long period of disunion. Among the torchbearers on that occasion was the present Emperor of Germany.

During the later period of his life Kekulé was comparatively sterile. Those who knew him, however, Professor Thorpe says, "would be the first to affirm that this seeming apathy sprang from no natural indifference. There is no doubt that he suffered, even in the early period of middle life, from the intense stress and strain of his mental labors prior to the Ghent period. He too surely exemplified the sad truth of Liebig's saying that he who would become a great chemist must pay for his pre-eminence by the sacrifice of his health. There is reason to know that it was the consciousness of failing power which prevented him from finishing much to which he had put his hand, and that his fastidiousness and his sense of 'finish,' amounting almost to hypercriticism, restrained him from publishing much which he realized fell short of his ideal."

The last time Kekulé's name was brought before the public was on the occasion of the renewal of the ancient title of nobility of his family, as August Kekulé von Stradowitz.

Editor's Table.

A VOICE FROM THE PULPIT.

WE called attention last month to a weak attack on the doctrine of evolution by a certain Mr. A. J. Smith, Superintendent of Public Schools in the city of St. Paul. The only thing which gave any consequence to the deliverance in question was that it was addressed to a large gathering of public-school teachers, who might possibly have been unduly influenced in their appreciation of it by the speaker's official position. We are glad now to learn that, very shortly after the publication of Superintendent Smith's address, an excellent statement of the true relation of the doctrine of evolution to education was made in one of the city pulpits by the Rev. S. G. Smith, who did not boast, as the superintendent had done, of having made an exhaustive study of the subject, but who, nevertheless, showed that he had a grasp of it which the other altogether lacked. The Rev. Mr. Smith's discourse would have merited attention wherever it might have been delivered; but, considered as a pulpit utterance, it seems to us to possess a special and very encouraging significance. We need hardly say that the pulpit has not always been friendly to broad scientific views, but in this case it has spoken with a candor, a breadth, and an intelligence which the lecture platform can not do more than equal, and which it would certainly be too much to look for in all our colleges.

"The law of evolution," said the reverend gentleman, "is as universal in its application as the law of gravitation. It holds that in every realm the simple tends to become complex, and that the complex is more stable than the simple. Motion and matter have a history in which the simple and the indefinite take on variety of organization and definiteness of adaptation." This is a statement in which the author of the Synthetic Philosophy would probably have very little change to suggest. Mr. Smith does not, like so many who discuss the subject in a superficial manner, confound evolution with Darwinism. Darwinism, he recognizes, may, in its particular explanations as to the origin of species and the descent of life, be in error; but evolution is universal in its scope, and can only fail if it can be shown that the fundamental postulates on which it rests, such as the instability of the homogeneous, the continuity of motion, the law of rhythm, etc., are not to be depended on. Must a person have made the circle of the sciences and comprehended all knowledge before he can reasonably profess a belief in evolution? No, says Mr. Smith; when the foundations of a doctrine have been clearly laid, when they have been tested by many different investigators from many different points of view, and when these, almost without exception, affirm that the doctrine is not only in harmony with, but lends a new and deeper significance to, the several orders of fact with which they are individually concerned, any person of ordinary intelligence is justified in considering that doctrine as satisfactorily proved and giving it his personal adhesion.

What chiefly excited the ire of Superintendent A. J. Smith was the contention of evolutionists that the modern child reflects the earlier stages of human development. He asked his audience if they really thought the children of to-day were young savages, and quoted Emerson and Longfellow as authorities on the question. The Rev. S. G. Smith takes up the point and expresses himself as follows: "When it is stated that the child has many points of contact with primitive man, it is not meant that the child is a savage, but that 'in its immaturity' we can learn much respecting it from the study of child races. The child has neither the virtues nor the vices of the savage, but he has many of the mental characteristics. Embryology does not teach that in prenatal life the child passes into the form of every animal in a menagerie, but that its life passes through the stages that mark the great subdivisions of all life. Nor do the comparisons of the child with primitive man imply that he must pass through all the activities of savage races, but that the development of his faculties, the tendencies of his desires, the state of his ignorance, all illustrate the history of the development of the race. Primitive man may be understood by a study of the child, and, conversely, the child may be illustrated by primitive man."

It must be borne in mind that the child is in constant contact with its elders, that it is subject to the restraints which they impose, and that it lives more or less in an atmosphere of affection and care. There is excellent reason, therefore, why it should not resemble primitive man in all points. Its daily life is really controlled and guided by a higher power. In some cases there is even too much control and guidance; the conditions are made too artificial, and the development of the child's nature suffers in consequence. When the age of manhood or womanhood is reached there is something lacking, precisely because enough scope was not left for the primitive or, as we may very properly say, the "savage" instincts of childhood. A great French writer, Joseph de Maistre, quotes a popular saying to the effect that "spoilt children always turn out well."* So far as there is any truth in it, the explanation is that the spoilt child is one that has a great deal of its own way, and is left to work out the savage and so acquire a sounder foundation for its future life. In how many of us are there not chained savages that might have made their escape in earlier years if they had only been allowed! It is a dangerous thing to try to make little angels of children.

The Rev. Mr. Smith is quite right in what he says as to the predominance of the imagination in children, this being another strong point of resemblance to primitive man. "The beginnings of history and institutions," he truly says, "can only be understood when we remember that races in their early development do not have clearly marked activities of imagination, reason, and memory. They mix the three. So legends, myths, and heroics are earnest efforts of the undeveloped mind to make objective the truth, and are not clumsy lies at all." Applying this to the child, the conclusion is that "he must be fed through his imagination or he will not grow." A very imaginative child is apt to be accused of falsehood, when he simply fails to distinguish between things imagined and things remembered. Neither the child nor the savage can concentrate his attention, and to force either to do so beyond a certain very limited measure is simply to injure and deform such natural powers as he possesses. The amount of mischief which a dogmatic and over-logical teacher, wholly ignorant of the psychology of the child, can do is beyond all calculation.

* "Les enfans gâtés réussissent toujours."

It is needless, however, to pursue the parallel further, though the Rev. Mr. Smith very properly carries it into the region of morals, where it is no less close than in that of intellectual action. There is another interesting aspect of evolution which the reverend gentleman glances at, and that is its bearing on general courses of study. History and literature, considered as departments of research, it has largely transformed by substituting for conventional categories and abstract notions the perception of a genetic process pervading all the works of the human spirit and linking them into an organic unity. In conclusion, we may observe that, if Superintendent A. J. Smith had not made some foolish remarks in a rather ostentatious manner, it is probable the Rev. S. G. Smith would not have delivered the excellent discourse on which we have commented, and which we feel sure will far outweigh in general effect the performance which called it forth. The conclusions to be drawn are the pleasing ones that good may sometimes come out of evil, and that a free pulpit is admirably adapted to guard the interests of liberty and common sense.

LESSONS OF ANTHROPOLOGY.

THE address delivered at the last meeting of the British Association by the president of the Anthropological Section contained nothing that was strikingly novel—it is not every year that striking novelties can be announced—but it dealt in an interesting manner with several phases of a most important subject. The speaker, Professor Brabrook, took the position that the order of the universe is expressed in continuity, not cataclysm, and that this principle will be found illustrated in every branch of anthropological research, in direct proportion to the completeness of the data obtained. He admitted the vastness of the gap which still separates the remains of palæolithic from those of neolithic man, but expressed the belief that further explorations would bring intermediate relics to light. To quote the speaker's words: "The evidence we want relates to events which took place at so great a distance of time that we may well wait patiently for it, assured that somewhere or other these missing links must have existed, and probably are still to be found."

Reference was made to the labors which are now being usefully expended in gathering what is called the folklore of various communities, and to the result which continually appears with fuller evidence, namely, that the tendency of mankind everywhere is to develop like fancies and ideas at a like stage of intellectual development. Full of detail as these stories are, they are found to contain but a few primitive ideas; and it seems not improbable that to a large extent they are essentially Nature myths. Mr. Brabrook happily quotes Lord Bacon's description of such narratives as "sacred relics, gentle whispers and the breath of better times." The "better times" are a part of the general system of myth; but who will deny that there is a special charm in these early documents of our race? "Let one of our literary exquisites," said a thoughtful French writer, "try to write a fairy tale which shall neither be a pretentious apologue nor a tiresome and transparent allegory, and he will soon feel that mere cleverness does not suffice to create these marvelous narratives, and will conceive a just admiration for those who constructed them, that is to say, everybody and nobody."

The progress of anthropology,

according to the president of the section, seems more and more to confirm the theory adopted by Fustel de Coulanges in France and Spencer in England, that the belief in spirits lies at the basis of all religious systems. We thus see, to use his words, "that the group of theories and practices which constitute the great province of man's emotions and mental operations expressed in the term 'religion' has passed through the same stages, and produced itself in the same way, from rude early beginnings, as every other mental exertion." Mr. Brabrook mentions a work lately published by "a distinguished missionary of the Evangelical Society of Paris," the Rev. Mr. Coillard, in which an account is given of the superstitions prevailing among the natives of the upper Zambesi. The reverend gentleman tells of their belief in witchcraft, and gives a story of a young woman who was condemned to penal labor on suspicion of having bewitched, or tried to bewitch, another young woman who had taken her husband from her; the evidence of the crime being found in a dead mouse, which had been discovered in the second young woman's chamber. The missionary says: "She was made a convict. A few years ago she would have been burned alive. Ah, my friends, paganism is an odious and a cruel thing!" On which the president of the Anthropological Section observes: "Ah, Mr. Coillard, is it many years ago that she would have been burned alive or drowned in Christian England or Christian America? Surely the odiousness and the cruelty are not special to paganism any more than to Christianity." This is much to the point. If witchcraft is no longer a recognized crime in England or America, it is not because these lands are Christian, but because science is mixed with their Christianity. Even missionaries ought to know this.

A great many different sciences are grouped under the name "anthropology," but they all have their rallying point in man, whose nature and history they seek to explore. The fact is that all sciences should have the same rallying point; and we trust that the greater interest which is visibly being taken year by year in anthropological studies will tend to humanize in a beneficial degree the whole circle of human knowledge.

AN EXAMPLE OF SOCIAL DECADENCE.

THAT the incessant encroachment of the Government upon the rights of the individual will produce social decadence is a truth that most Americans have yet to learn. With a light heart they are constantly approving scheme after scheme for social regeneration that involves some restriction upon freedom, or an increase of taxation, or both. It is not perhaps singular that the history of similar schemes in the past should possess no lesson for them. When President Eliot, of Harvard University, says that the experience of the Italian republics has no value for us, it is not to be expected that persons with less capacity to interpret the records of other times should attach little or no importance to them. But they ought not most certainly to maintain the same attitude toward the experience of the nations of today. It is to blind their eyes to what does not rest upon hearsay or upon dubious documents—to what admits of the clearest demonstration at the hands of living witnesses.

For this reason we urge upon all students of social science the study of the condition of the inhabitants of the black-earth region of Russia. In that field, one of the largest and most fruitful in the world for investigation, they will find the amplest evidence of the frightful havoc wrought by the abridgment of individual freedom and the seizure of private property in the form of taxes for public purposes. If it be said that Russia is an autocracy, and can not therefore furnish instruction to a democracy like the United States, the answer is easy, if not obvious. Despotism, like gravitation, is the same all over the world. It makes no difference in the long run whether a law abridging freedom issues from the palace of a czar or from the legislative halls of a popular assembly. The individual objecting to it is obliged to regulate his life, not in accordance with his own notions, but in accordance with the notions of some one else. It makes no difference, either, whether taxation is imposed by an imperial edict or by a legislative vote. The citizens that have to bear it against their will contribute money for purposes that some one else only approves of. The only difference between Russia and the United States is that this kind of despotism has been carried to much greater lengths in one country than in the other. If, therefore, we can find out what the effect has been in Russia, we will be able to predict what the effect will be in the United States.

As every person familiar with Russia knows, the black-earth region is one of the richest and most productive in the world. It ought to be inhabited by one of the wealthiest and happiest of peoples. Yet such is not the case. According to Count Tolstoi, who contributed recently a letter to the London Times on the subject, the inhabitants are among the poorest and most miserable in the world. They are in a state of chronic starvation. They are obliged to content themselves with nearly a third less food than is sufficient to maintain normal health. The physical effect of this insufficiency of food is a decrease in vitality, a diminished stature, and a check to the growth of population. It is proved, first, by the failure of the peasants of the region to meet the requirements for military service, and, second, by the statistics of population, which show that the increase of births over deaths has fallen from the maximum reached twenty years ago to zero.

But the mental effects of the destitution wrought by the robberies of the Government are more distressing even than the physical. It gives birth to a stolidity and despair that tend to paralyze all effort toward betterment. The people subjected to it come to feel that there is no use of making any struggle beyond the maintenance of mere existence. Whatever they get in excess of this requirement will be taken from them. "A peasant," says Tolstoi, illustrating this fact, "feels that his position as an agriculturalist is bad, but he believes that it can not be improved; and, consequently, adapting himself to this hopeless position, he no longer fights against it, but lives and acts only in so far as he is stirred by the instinct of self-preservation. Moreover, the very wretchedness of his condition increases still more his depression of spirit. The lower the economic condition of a population sinks, like a weight on a lever, the more difficult it becomes to raise it again; the peasants feel this, and, as it were, throw away the helve after the hatchet. 'Why should we trouble ourselves?' they say. 'We sha'n't get fat. If we can only keep alive.'"

The fruits of this mental state are as palpable as those of the lack of food. They are to be found in every direction. In manners, habits, and customs the peasants are hopelessly conservative. They belong, not to the nineteenth century, but to the ninth. Instead of adopting new and improved methods of agriculture, they cling to those of the subjects of Rurik. They use the old plow, distribute tillage in three crops, and divide their fields into long, narrow strips. So slowly do they toil with primitive implements and debilitated animals, and so indifferent are they to what they are doing, that it takes them a day to do the work that a well-fed and alert peasant would do in half the time. A more deplorable sign of demoralization is the prevalence of family discord and loss of interest in a higher life. The aggressions of the state have stimulated selfishness, bad temper, and incipient rebellion. The children disobey their parents, the younger brothers reject the primacy of the older, and money earned elsewhere is kept from the family treasury. With the decadence of family life there is a decadence of religious life. Although the peasants are nominally orthodox, they care nothing for religion. Even the clergy confirm the fact that they are becoming more and more indifferent to the church. What they seek is not to penetrate the mysteries of life, but to obliterate consciousness of them. "Under these circumstances," says Tolstoi, alluding to the economic and mental decadence, "the craving for forgetfulness is natural, and accordingly spirits and tobacco are being consumed in ever greater and greater quantities." He adds that "even quite young boys drink and smoke."

Since the loss of freedom due to the seizure of property is the same in the last analysis as that due to an abridgment of the right to think and act, the evils of ecclesiastical and bureaucratic despotism do not differ from those of excessive taxation. Nevertheless, they receive separate attention at the hands of Tolstoi. As a proof of the blight of a church that the peasants have no part in directing, he points to the profound and beneficent change wrought the moment they fall in with a sect of dissenters. "Their spirits at once rise," he says, "and at the same time the foundation of their material prosperity is laid." A blight of the same kind can be traced to the attempt of the state to play the paternal rôle. "Nominally," says Tolstoi again, "there exist for the peasants special laws with regard to the possession and division of land, to inheritance, and to all the duties connected with it, but in reality there is a kind of hodge-podge of regulations, explanation, customary laws, decrees of courts of cassation, and so on, which naturally makes the peasants feel their absolute dependence on the will of innumerable officials." Knowing that they are powerless to resist the Government, which is constantly flogging them for disobedience or stupidity, they comply as best they can with the thousand rules and regulations made for them. Seldom do they think of acting upon their own responsibility. Thus they lose the power of private initiative. What the impoverishment of taxation has not done to ruin them is left to ecclesiastical and bureaucratic despotism to complete.

It is curious to note that Tolstoi's remedy for these evils is the one that Herbert Spencer himself might have suggested. With one stroke he dismisses the prescriptions that the social reformer in the United States as well as in Russia attaches so much importance to. It is not, in his opinion, "the ministry of agriculture, with all its contrivances," that will reclaim the peasants, nor is it "exhibitions nor schools for rural economy," nor that "unfailing" remedy "for all evils," i. e., parish schools. The thing they need is freedom. "It is necessary," says Tolstoi, "to give them religious liberty, to subject them to common instead of special laws—the will of rural officials; it is necessary to give them liberty of education, liberty of reading, liberty of moving about, and, above all, to remove the power to torture brutally by flogging grown-up people simply because they belong to the peasant class." But to give them such freedom means to deliver them not only from excessive taxation but from vexatious rules and regulations. It is to apply to them the same remedy that must be applied in the United States to save the American people, now so heavily taxed and so oppressed by countless laws, from the same social decadence that afflicts Russia.

THE ADVANCE OF SCIENCE.

THE paper by Sir J. Norman Lockyer, which we publish in this number, recounts in an interesting manner the steps by which science gained a place for itself in the educational systems of the world. To us, in the latter years of the nineteenth century, it is apt to seem strange that the recognition of science as an essential element in all education should have come so late in the world's history; but reflection shows that it could not well have been otherwise. To view and examine any subject scientifically involves not only a deliberate and prolonged mental effort, but the holding in check of some of the most active propensities of the human mind, such as imagination and what Bagehot has called "the emotion of belief." In a certain sense imagination is the precursor of science; but, in the early stages of human development the precursor is mistaken for the true teacher. The lesson that there is no royal road to truth, nothing but a highway on which much wearisome plodding must be done, is one which human nature in general does not take to kindly. Even in the present day how many there are who chafe at the restraints which Science imposes on belief, whose disposition is to break her bonds asunder and have none of her reproof! When we think, indeed, of what the intellectual condition of the world is to-day, with the wonders which science has wrought raising their testimony on every hand, it is hardly surprising that, a couple of centuries ago, it was difficult to get any systematic provision made for the teaching of science. However, that battle has been fought and won, and Science has long since definitely entered on her career of beneficent conquest. Systems founded on imagination, or on merely abstract reasoning, come and go, wax and wane; but the empire of science once set up can never be subverted. We must hope that some day it will rule in the realm of morals as now it does in that of material things. Not till then will its perfect work be done.

Scientific Literature.

SPECIAL BOOKS.

PROF. *Dean C. Worcester*, of the University of Michigan, spent eleven months, beginning in September, 1887, in the Philippine Islands in connection with the second scientific expedition of Dr. J. B. Steere. He went there again, with an expedition of which he was chief, in July, 1890, and spent two years and eight months. His object in both expeditions was the study of birds. In the course of them he visited twenty-two islands. The first expedition was unofficial and was regarded suspiciously by the authorities of the islands; the second was armed with a special permission from the Spanish Minister of the Colonies and enjoyed every advantage. The scientific results of both were reported to the United States National Museum, and the collections were deposited in its cabinet. The general results, the story of the adventures of the members of the expedition, with their observations on the geographical features of the islands, their peoples, and the social conditions prevailing there, are given in a popular style in the volume before us.* The account is preceded by a short sketch of the history of the islands, as an aid to the better comprehension of their present condition and the reasons for it. Of the natives, who form the bulk of the 8,000,000 of the population of the islands, there are more than eighty distinct tribes, each with its own peculiarities, scattered over hundreds of islands. The more important of these islands may be reached by lines of mail and merchant steamers, which afford tolerably frequent communication between them. The difficulties begin when one attempts to make his way into the interior of the large and less explored of them, or desires to reach ports at which vessels do not call. Roads are scarce and to a large extent impracticable, while enemies and dangers are many, and such boats as one can find off the regular routes are precarious. As to climate, if one is well, able to live as he pleases, and most scrupulously observes all sanitary rules, keeping the most healthy spots, he may escape disease; but if he steps a little aside at any point he is in danger. It is very doubtful, in the author's judgment, if many successive generations of European or American children could be reared there. Evidences of the action of earthquakes and volcanoes are seen almost everywhere, and elevation and subsidence are going on with great rapidity at the present time. Hence it is not safe to build substantial houses in Manila. The soil is astonishingly fertile: fruits—in about fifty varieties—are the chief luxury; the value of the forest products is enormous; the mineral wealth is great, but has never been developed. Professor Worcester speaks of five millions of civilized natives of the Philippines. They belong for the most part to three tribes: the Tagalogs, Ilocanos, and Visayans. Without drawing fine distinctions between these, they are regarded as showing sufficient homogeneity to be treated as a class. They have their bad qualities and their good, which are reviewed with an apparent inclination on the part of the author to like them, and the conclusion that, having learned something of their power, they will now be likely to take a hand in shaping their own future. There are also barbarians, of whom the Moros of Sulu are a type—bloodthirsty and faithless, and as careless of human life as one would be of weeds in a field; and savages of all degrees, down to the lowest. The government is various, according to the particular governor and the people he has to deal with, but all of the Spanish or Moro type. The clergy are the dominant class; and of these the friars or brethren of the orders exert an evil influence, while the Jesuits are believed to be a distinctive power for good. Much can be said in favor of the insurgents' demand that the friars be expelled from the colony and their places taken by secular clergymen not belonging to any order. Professor Worcester has

* The Philippine Islands and their People. A Record of Personal Observation and Experiences, with a Short Summary of the More Important Facts in the History of the Archipelago. By Dean C Worcester. New York: The Macmillan Company. Pp. 529. Price, $4.

made a very lively, interesting, and instructive book, which is marred, however, by occasional evidences that, while begun with serious purpose, it has been hurried to meet a passing demand, and by the too frequent intrusion of trivialities and slang.

We are often surprised at manifestations of individuality and intelligence in domestic animals and pets, and are accustomed to attribute extraordinary qualities to the beasts in which we perceive them ; as if each animal could not have its peculiar traits and talents as well as each man. We hardly imagine that there are any special differences in wild animals, and that idiosyncrasies of character and diversities of gifts and powers of adaptation may run through the whole animal kingdom. A closer acquaintance with Nature would teach us better. Certain stories and myths of savages show that they had a fair appreciation of the individual peculiarities of animals, and farmers' boys, who live in natural surroundings, know something of these things. The subject is now presented to us in a fairly clear light by Mr. *Ernest Seton Thompson*, as illustrated in the careers of a number of typical specimens of animals and birds whose characters and acts, as they came under his observation, are related in *Wild Animals I have Known.** The stories, he avers, are true ; the animals in the book are all real characters. They lived the lives he has depicted, and showed the stamp of heroism and personality more strongly by far than it has been in the power of his pen to tell. Among them was Lobo, the wolf, of the Corrumpaw Cattle Range, New Mexico, the leader of a gang, who exhibited some of the qualities of an able general, and was a beast of influence, powerful, vigilant, crafty, and the terror of the settlement ; and who was only trapped when grief for the loss of a female companion deprived him of the wit by which he had escaped all previous efforts to take him. Silverspot, the crow, was the leader of a large band. He had his calls, which the other crows obeyed, and was always to be seen at the head of his company in their incursions into the fields, and guiding them in their journeys northward and southward. Raggylug, the rabbit, is acknowledged to be a composite, embodying in one the ways of several rabbits, their nesting habits and ways of concealment and devices to baffle pursuers. Bingo, the dog, had associates as well as enemies among the wolves, and different characters by day and by night. In a similar way to these, the traits of the fox, the pacing mustang, other dogs than Bingo, and the partridge are portrayed. In all the stories the real personality of the individual and his view of life are the author's theme, rather than the ways of the race in general, as viewed by a casual and hostile human eye. The moral is suggested by the lives and emphasized by Mr. Thompson, that "we and the beasts are kin. Man has nothing that the animals have not at least a vestige of ; the animals have nothing that man does not at least in some degree share. Since, then, the animals are creatures with wants and feelings differing only in degree from our own, they surely have their rights." It would be hard to speak too well of the graphic expressiveness of the illustrations.

* Wild Animals I have Known, and 200 Drawings. By Ernest Seton Thompson. New York: Charles Scribner's Sons. Pp. 358. Price, $2.

GENERAL NOTICES.

"An unscientific account of a scientific expedition" is what Mrs. Mabel Loomis Todd happily styles the story of the Amherst Eclipse Expedition, told in *Corona* and *Coronet* *—"Corona" being what the expedition went to see, and "Coronet" the vessel that took it to the observing station. Professor Todd was the astronomer of the party, and Mrs. Todd, who has published a work on astronomy, was his companion. She believes that certain aspects of the trip, covering as it did more than ten thousand miles of sailing for the party, and at least forty five thousand miles of deep-sea voyaging for the Coronet, were worthy of narration. The astronomical purposes of the expedition, the objects it sought to obtain, the scientific bearings of the observations, and the methods, are intelligibly set forth in the introduction to the book. The rest is devoted mostly to narrative, the social aspects of the voyage, and the incidents. A short sojourn was made at the Sandwich Islands, where the more interesting objects were visited. Mrs. Todd was with Kate Field when she died there, and gives an account of her last hours. A voyage of four weeks carried the party to Yokohama, whence some of the members went to the capital and other interesting points in Japan, while the rest were preparing the observing station at Esashi, eleven hundred miles north of Yokohama—"a village on the shores of the Sea of Okotsk, among the hairy Ainu," in a region so remote that the native steamers had only recently begun to go there at all. Besides the account of the observations, descriptions are given of such Japanese experiences as life in Kioto, cormorant fishing, yachting in the Inland Sea, the tidal wave, and observations among the Ainu, with a visit on the way home to an Arizona copper mine.

The late Prof. *James D. Dana* had begun a revision of his *Text-Book of Geology* a short time before his death. Prof. William North Rice was requested by his family to complete the revision, and the result is the present volume.* It was intended in the original plan of revision to preserve as far as possible the distinctive characteristics of the book. It was to be brought down to date as regards its facts, but was still to express the well-known opinions of its author, with the general plan of arrangement kept unchanged. It soon became evident, however, that more and greater changes than had been contemplated would be required. The zoölogical and botanical classifications would have to be modified; the theory of evolution must have more recognition than it had received, especially as Professor Dana himself had adopted some of its features before his death; and the treatment of metamorphism was believed to require considerable modification. In the present edition the bearing of various events in geological history upon the theory of evolution is pointed out in the appropriate places, and the general bearing of paleontology upon evolution is discussed in the concluding chapter. All these changes seem to be in the line of continuing the usefulness of Professor Dana's most excellent and standard work, and of keeping his name before students as that of "one of the greatest of geologists and one of the noblest of men."

A true son of Nature is Mr. *F. Schuyler Mathews*, and he shows himself at his best in his *Familiar Life in Field and Forest.*† "There are few things," he says, "more gratifying to the lover of Nature than these momentary glimpses of wild life which he obtains while passing through the field or forest. Wild animals do not confine themselves exclusively to the wilderness; quite frequently they venture upon the highway, and we are apt to regard the meeting of one of them there as a rare and fortunate occurrence. The daisy and the wild rose appear in their

* Corona and Coronet: Being the Narrative of the Amherst Eclipse Expedition to Japan, in Mr James's Schooner Yacht Coronet, to observe the Sun's Total Obscuration, August 9, 1896. By Mabel Loomis Todd. Boston and New York: Houghton, Mifflin & Co. Pp. 383. Price, $2.50.

* Revised Text-Book of Geology. By James D. Dana, LL. D. Fifth edition, revised and enlarged. Edited by William North Rice. American Book Company. Pp. 482.

† Familiar Life in Field and Forest. The Animals, Birds, Frogs, and Salamanders. By F. Schuyler Mathews. New York: D. Appleton and Company. Pp. 284. Price, $1.75.

accustomed places on the return of summer, and the song sparrow sings in the same tree he frequented the year before; but the woodchuck, the raccoon, and the deer are not so often found exactly where we think they belong. To seek an interview with such folk is like taking a chance in a lottery; there are numerous blanks and but few prizes. But because wild life is not in constant evidence, like the wild flower, is no proof that it is uncommon. To those who keep in touch with Nature, it becomes a very familiar thing, and to live a while where the wild creatures make their homes is to cross their paths continually." Mr. Mathews is in touch with Nature. He does not exactly know where to find the wild and shy, for they do not come at call, but he can put himself where he will meet them if they come around —and "one can never tell at what moment some surprising demonstration of wild life will occur at one's very doorstep." In this book Mr. Mathews records some of his meetings, at home and in his daily walks, offering as his excuse for the record, that he has lived long enough among wild animals to "respect their rights of life, and speak a good word for them when occasion offers."

The *Short Manual of Analytical Chemistry*,* prepared by Mr. *John Muter*, follows the course of instruction given in the South London School of Pharmacy. Encouraged by the continued favor which the book has received in Great Britain, the author offers a special edition of it to American students, a concise and low-priced manual, designed to introduce them to the chief developments of analytical chemistry from the simplest operations upward. It includes many organic questions generally overlooked in initiatory books. By working through it the author claims the student may expect to become familiar with a great variety of processes, and to be in a position to use with satisfaction the more exhaustive treatises dealing with any special branch he may desire to follow. In preparing it for American students, the directions, wherever the British methods differ from the American, have been modified to agree with the latter. The processes given include the qualitative analysis, all the general operations and those relating to detection of the metals, of acid radicals and their separation, of unknown salts, of alkaloids and certain organic bodies used in medicine—with a general sketch of toxicological procedure; and in quantitative analysis, directions on weighing, measuring, and specific gravity; gravimetric analysis of metals and acids, ultimate organic analysis, special processes for the analysis of air, water, and food; analysis of drugs, urine, and calculi; and analysis of gases, polarization, spectrum analysis, etc.

The pure geometry of position is mainly distinguished, according to Professor Reye's definition,* from the geometry of ancient times and from analytical geometry, in that it makes no use of the idea of measurement. Nothing is said in it "about the bisection of segments of straight lines, about right angles and perpendiculars, about ratios and proportions, about the computation of areas, and just as little about trigonometric ratios and the algebraic equations of curved lines, since all these subjects of the older geometry assume measurement. . . . We shall be concerned as little with isosceles and equilateral triangles as with right-angled triangles; the rectangle, the regular polygon, and the circle are likewise excluded from our investigations, except in the case of these applications to metric geometry. We shall treat of the center, the axes, and the foci of so-called curves of the second order, or conic sections, only as incidental to the general theory; but, on the other hand, shall become acquainted with many properties of these curves, more general and more important than those to which most text-books upon analytical geometry are restricted." Of all the other branches of geometry, the descriptive is the most helpful in facilitating the study of the geometry of position; and perspective or central projection plays an important part in it. It stands in a certain antithetical relation to analytical geometry on account of its method, which is synthetic, and whence it is some-

* A Short Manual of Analytical Chemistry, Qualitative and Quantitative, Inorganic and Organic. By John Muter. Second American edition. Illustrated. Adapted from the eighth British edition. Philadelphia: E. Blakiston, Son & Co. Pp. 228. Price, $1.25.

* Lectures on the Geometry of Position. By Theodor R. Reye. Translated and edited by Thomas F. Halgate. New York: The Macmillan Company. Pp. 148. Price, $2.25.

times known as synthetic geometry. Since metric relations are not considered in it, its theorems and problems are very general and comprehensive. As presented in von Standt's complete work, it is regarded by the author as an excellent aid to the exercise and development of the imagination; and the important graphical methods with which Professor Culmann has enriched the science of engineering in his work on graphical statistics, being based for the most part upon it, a knowledge of it has become important for students of that science. In the present work, the outgrowth of his lectures, Professor Reye has attempted to supply the want of a text-book which shall offer to the student the necessary material in a concise form.

Prof. *Cyrus Thomas* brings the qualification which a lifetime devoted to study of the subject develops, to the preparation of an *Introduction to the Study of North American Archæology*.* He is known to all students in this branch as a careful, judicious investigator whose work in the field has been supplemented by valuable contributions to its literature. In this volume he presents a brief summary of the progress that has been made in the investigation of American antiquities—which has been recently great indeed, and well calls for a new synopsis. His chief object has been to present the data and arrange them so as to afford the student some means of bringing his facts and materials into harmony, and of utilizing them. He presents the theories that have been advanced, and mentions opposing views; regarding it, he says, as important to the progress of the student to know which of the questions that arise have been answered, and which hypotheses have been eliminated from the class of possibilities. The materials for the study and the methods are first explained. The relics of ancient men and the mounds are then described as under three divisions—the Arctic, the Atlantic, and the Pacific. Local as well as regional characteristics and differences are pointed out; as in the mounds as a whole, the special class of animal mounds, the pueblcs, the cliff dwellings, and the Mexican and Central American monuments, the peculiar features of each are pointed out, and their territorial limits are defined. All these varions kinds of works are ascribed to substantially the same people, who are supposed to have come down from somewhere in the north or northwest (the extreme northwest Pacific coast), although the different immigrations may perhaps have arrived by various routes. The people were the present Indians or their ancestors; the time of the immigration was not extremely remote; and the "mound-building habit" is shown to have persisted and been practiced till since the advent of the Europeans.

In entitling his book *The Art of Taxidermy*,* the chief of the Department of Taxidermy in the American Museum of Natural History evidently intends to use the word art in the high sense of a fine art; for he speaks of the enormous strides toward perfection which it has made from the former "trade of most inartistically upholstering a skin"—stuffing it, we used to call it—and of its study having been taken up of late years by a number of men of genius and education. It is largely owing to the exertions of these men that the taxidermy of the present day is so far in advance of what it was a decade since. The proverb says that art is long, and accordingly Mr. Rowley takes for the motto of his book a sentence from Thoreau, that "into a perfect work time does not enter." To the possible objection that some of his methods seem to involve considerable time and expense, the author replies in substance that if the work is not worth this, it is hardly worth while to take it up at all. If it is a proper work, and one has the proper degree of energy and enthusiasm, let him give the specimen all the time it demands. In preparing his treatise, the author has aimed to eliminate all extraneous matter, and to give mainly the results of his own experience, coupled with that of other taxidermists with whom he has come in contact. He begins with instructions about collecting tools and materials, and casting, and treats further of the preparation of birds, of mammals, and of fish, reptiles, and crustaceans; the cleansing and mounting of skeletons, and

* Introduction to the Study of North American Archæology. By Prof. Cyrus Thomas. Cincinnati: The Robert Clarke Company. Pp. 391.

* The Art of Taxidermy. By John Rowley. New York: D. Appleton and Company. Pp. 244. Price, $2.

the reproduction of foliage for groups. The appendix contains addresses of reliable firms from whom tools and materials used in taxidermy may be purchased.

The preparation of this book on *The Storage Battery* was suggested to Mr. Treadwell * by his finding a lack in working on these machines of any compact data concerning their construction, and the paucity of reliable discharge curves; and he concluded that a book containing such data and curves, with rules for the handling and maintenance of cells, would be valuable to all interested in storage batteries as well as to the student and manufacturer. Among the points specially mentioned by the author are the lists of American and foreign patents given as footnotes for the various types, not complete but noticing the principal patents for each cell; the chapter on the chemistry of secondary batteries, which gives the latest and most generally accepted theory concerning the chemical reactions taking place in an accumulator, and which has been approved by Dr. Sewal Matheson; and, in the appendix, tables of data comprising figures of all the batteries, methods for the measurement of the E. M. F. and internal resistance of a storage battery; and data from which the theoretical and practical capacity of an accumulator may be determined.

The *Natural Advanced Geography* † is a successful application of modern methods to the teaching of this science, and presents it with the interest undiminished which really appertains to it. While in the elementary book of this, the "natural" series, the pupil starts from his own home and is introduced to the study of man in relation to his environment, in the present work the fact is developed that environment itself is the chief factor in the various activities and economies of man. One of the salient features of the presentation of the subject, marked throughout the work, and one that commands high praise, is the arrangement of the facts into such order that their correlation may be perceived and the unity of Nature recognized. The isolated, barren, curt, unrelated statements that made the study of many of the old geographies hard and tedious are conspicuously absent, and the subject, studied in orderly sequence, "unfolds itself naturally and logically, each lesson preparing the way for those which follow." The first part of the work is devoted to a study of the world as a whole. The second part, comprising about three fourths of the volume, is an application of these laws to the various countries of the globe, beginning with the United States. In the United States, for instance, a general description of the whole is given, which presents a real, comprehensive mental picture of the country; and the process is repeated, in measure according to the conditions, for the several States, so that the pupil is taught what are the factors that give the characteristics and local features to each. A like method is pursued, on a more general scale, with other countries. The colored maps are drawn on a system of uniform scales, with reliefs plainly shown according to the accepted conventions; graphic charts or sketch maps showing the distribution of products and resources are employed; and pedagogical exercises and aids are afforded abundantly.

A text-book on the *Differential and Integral Calculus*,* for students who have a working knowledge of elementary geometry, algebra, trigonometry, and analytical geometry, by Prof. *P. A. Lambert*, has the threefold object of inspiring confidence, by a logical presentation of principles, in the methods of infinitesimal analysis; of aiding, through numerous problems, in acquiring facility in the use of these methods; and, by applications to problems in physics, engineering, and other branches of mathematics, to show the practical value of the calculus. By a division of the matter according to classes of functions, it is made possible to introduce these applications from the start, and thereby to arouse the interest of the student. By simultaneous treatment of differentiation and integration and the use of trigonometric

* The Storage Battery. A Practical Treatise on the Construction, Theory, and Use of Secondary Batteries. By Augustus Treadwell. New York: The Macmillan Company. Pp. 257. Price, $1.75.

† Natural Advanced Geography. By Jacques W. Redway and Russell Hinman. American Book Company. Pp. 100.

* Differential and Integral Calculus. For Technical Schools and Colleges. By R. A. Lambert. New York: The Macmillan Company. Pp. 245. Price, $1.50.

substitution to simplify integration it is sought to economize the time and effort of the student.

The Birds of Indiana, by *Amos W. Butler*, lately published as part of Willis S. Blatchley's Twenty-second Annual Report on the Geology and Natural Resources of Indiana, is just at hand. It is one of the most accurate, detailed, and satisfactory local catalogues yet published. Three hundred and twenty-one species of birds have been taken in Indiana, and of each of these is given a detailed description, with a general account of its habits, song, migration, and nesting. In the case of the more rare species, full records of the dates and places of capture of the known specimens are appended. Analytical keys to genera and species are also given, so that every facility is furnished for the identification of species. This book is a model of its kind, and is a worthy fruit of Mr. Butler's twenty years of devoted study of the birds of his native State.

Robert H. Whitten, in his monograph on *Public Administration in Massachusetts*—the relation of central to local activity—pursues a parallel course with that taken by Mr. John A. Fairlie in a similar essay on the Centralization of Administration in New York State, of this same series of Columbia University studies in History, Economics, and Public Law. Having found the systems and tendencies of administration in the early settlement of Massachusetts all for expansion and decentralization, Mr. Whitten now perceives the course altogether changed, and centralization more and more the rule. The change corresponds with changes in the conditions of life, and keeps track with them step by step. Of great dynamic forces which have been set to work and are bringing about a complete reconstruction of the social structure, improvements in transportation and communication were the most vital—first, turnpikes, then the steamboat, railroad, and telegraph; then the horse railway, cheap postage, the telephone, the electric railway, and the bicycle. The tendency at first was to bring about a concentration which was attended by the congestion of population in cities and the depopulation of the rural towns. "The electric railway, the telephone, and the bicycle came in to counteract these evils; while their tendency is strongly toward the centralization of bureaus, it is also toward the diffusion of habitations. These great socializing forces, going hand in hand with the development of the factory system and improvement of machinery, make possible a vastly higher organization of society than was possible under a stagecoach *régime*."

The first volume of the Final Report of the State Geologist of New Jersey, on Topography, Magnetism, and Climate, was published in 1888. Other volumes embracing other topics have been published since, and in the meantime the supply of the first volume has been exhausted, while the demand has continued. It has been therefore necessary either to reprint the volume or to publish a new work which should include the important statistical matter of it. Accordingly, we have now *The Physical Geography of New Jersey*, prepared by Prof. *Rollin D. Salisbury*, with an appendix embodying "Data pertaining to the Physical Geology of the State," by Mr. C. C. Vermeule, who was formerly in charge of the topographic survey, and is author of the volume on water supply. The two parts of the volume treat of the topography of New Jersey as it now is, and the geological history of the topography. The report is accompanied by a relief map of the State, prepared by Mr. Vermeule on the basis of the topographical survey, and presenting, therefore, an accurate picture of the relief. It shows the great features of the State, its ranges of mountains, hills, tablelands, plains, marsh lands, streams, and water areas in their proper relations to one another; and it is contemplated to put it in every schoolhouse in the State as an aid in the study of geography.

M. *Imbert de Saint-Amand's* series of books about the Second French Empire furnish very interesting reading, are, so far as our recollection of events goes, historically accurate, and fill a gap which the literary world always has to suffer concerning any period too recently passed for a competent judicial mind to have appeared to tell its story. The second of the series—*Napoleon III and his Court*—takes Louis Napoleon at the height of his success and happiness, just after he had married the beautiful Eugénie, of whom the world has nothing harsh to say, and carries him through the period of his wonderful popularity and brilliant accomplishments to the close of the Crimean War and the birth of the prince whose fate was so unhappy. It deals, in a pleasant manner, and all favorable to Napoleon, but not adulatory, with affairs social, political, and military, in which it is hard to say whether the tact or the good fortune of the subject of the history shone most brilliantly. We are told how Eugénie won the French nation; of Napoleon's good will, especially manifested toward all that could contribute to his exaltation; of his dealings with the sovereigns around him, gradually winning their recognition, including that of Nicholas of Russia; of the darkening of the clouds of war, the Crimean campaigns; of the interchanges of courtesies, gradually rising into close, firm friendship, with the British court; and of the birth of the Prince Imperial. Think what we may of the character of the reign of Louis Napoleon and of its influence, it marked an epoch in nearly every line of development of the world's history, and was as distinctly separated from what came before it and from what followed it as if a broad line were drawn around it; and it left some important results that are not likely to be soon effaced. M. de Saint-Amand writes from personal knowledge, having witnessed or participated in much of what he describes, and has in Elizabeth Gilbert Martin a fully competent and acceptable translator. (Published by Charles Scribner's Sons. Pp. 407. Price, $1.50.)

The paper of the late Dr. *Theodor Eimer* on *Orthogenesis and the Impotence of Natural Selection in Species Formation* is published by the Open Court Company, Chicago, as No. 29 of their Religion of Science Library. Pp. 56. Price, 25 cents.

The second volume of Uncle Robert's Geography, of Appletons' Home-Reading Series—*On a Farm*—Mr. *Francis W. Parker*, the editor, and *Nellie Lathrop Helm*, emphasizes the importance of parents and teachers, giving full and complete recognition of the immense educational value of spontaneous activities as displayed in motive and interest; a recognition which "should be followed by active encouragement and direction of the child's play, work, and observations." The story deals entirely with the interests and life of children in the environment of the country. A little girl is in her playhouse in a Virginia fence corner, with her doll and mimic housekeeping. Her shy, retiring companions are the birds who peep into the playhouse, and, after she has gone away, come into it and pick up the crumbs she has left. This leads to talks about different birds and their nest building. A St. Bernard dog is introduced and furnishes the opportunity for bringing in stories of the Alps, their glaciers and snows, and the Hospice of St. Bernard, and then about other dogs. Susy makes a garden in the woods, and the wild flowers become the subjects of her spontaneous study. So with the rabbits, bread making and the grain that furnishes the material for the bread, and other incidents; with more birds' nests; the nature of bulbs, squirrels, etc.; and finally Uncle Robert sets the child to finding out how the animals in the woods spend the winter, and whether they are doing anything now in preparation for it. (New York: D. Appleton and Company. Price, 42 cents.)

The *Thirty-fifth Annual Report* of the Secretary of the State Board of Agriculture of Michigan includes the Ninth Annual Report of the Agricultural College Experiment Station, and is largely taken up with the work of the latter institution, reviewing the records of the college departments and presenting the reports and bulletins of the station. The record of meteorological observations, the Proceedings of the Farmers' Institutes, the Transactions of the Association of Breeders of Improved Live Stock, and the Transactions of the State Agricultural Society are also incorporated in the volume. An interesting feature of the publication is the insertion of a portrait and biographical notice of one of the pioneer farmers of the State, Enos Goodrich, who was also prominent in public life.

The translation by *Eleanor Marx Aveling* of Lissagaray's *History of the Commune of 1871* was made many years ago at the request of the author from a contemplated second edition which the French Government would not allow published. The work having been revised and corrected by the translator's father, and for other reasons, no changes have been made to adapt it to the time of its issue from the press. The translator claims that Lissagaray's work is the only reliable and accurate history that has yet been written of the Commune. He has not attempted, she says, to hide the errors of his party, or to gloss over the fatal weakness of the revolution. Of course, a very different view of the movement is given from that presented in the French accounts, as well as that generally held by English and Americans; but the communists have a right to be represented and heard, and it is well that they have so competent a spokesman. (Published by the International Publishing Company, 23 Duane Street, New York.)

PUBLICATIONS RECEIVED.

Academy of Natural Sciences of Philadelphia. Proceedings, 1898. Part II. April to September. Pp. 224, with plates.

Agricultural Experiment Stations. Bulletins and Reports. Cornell University: No. 152. Studies in Milk Secretion. By H. H. Wing and Leroy Anderson. Pp. 56; No. 153. Impressions of our Fruit-growing Industries. By L. H. Bailey. Pp. 18.—Iowa State College of Agriculture, etc.: No. 10. Anatomical and Histological Studies. Pp. 25, with plates.—New Hampshire College: No. 53. The Farm Water Supply. By Fred W. Morse. Pp. 12; The Winter Food of the Chickadee. By Clarence M. Weed. Pp. 16.—United States Department of Agriculture: The Chinch Bug. By F. M. Webster. Pp. 82; Some Books on Agriculture and Sciences related to Agriculture published in 1896-'98. Pp. 45; Forage Plants and Forage Resources of the Gulf States. By S. M. Tracy. Pp. 55; List of Publications relating to Forestry in the Department Library. Pp. 93.—University of Illinois: The Chemistry of the Corn Kernel. By C. G. Hopkins. Pp. 52.

Austin, Herbert Ernest. Observation Blanks for Beginners in Mineralogy. Boston: D. C. Heath & Co. Pp. 80. 50 cents.

Bailey, M. A. American Elementary Arithmetic. American Book Company. Pp. 205.

Beddard, Frank E. The Structure and Classification of Birds. New York and London: Longmans, Green & Co. Pp. 548.

Barnes's National Vertical Penmanship. Nos. A and B, and 1 to 6. American Book Company.

Bookseller, The, Newsdealer, and Stationer. Semimonthly. New York: 156 Fifth Avenue. Pp. 38. $1 a year.

Boutwell, Hon. George S. Problems raised by the War. Boston: Woman's Educational and Industrial Union. Pp. 20.

Bulletins, Reports, Proceedings, etc. Michigan Monthly Bulletin of Vital Statistics, October, 1898. Pp. 16.—National Pure Food and Drug Congress: Journal of Proceedings, March, 1898. Pp. 53.—United States Department of Labor: Bulletin No. 18, September, 1898. Pp. 124; No. 19, November, 1898. Pp. 42.

Card, Fred W. Bush Fruits. A Horticultural Monograph of Raspberries, Blackberries, etc. New York: The Macmillan Company. Pp. 537. $1.50.

Carpenter, Frank G. Carpenter's Geographical Reader. North America. American Book Company. Pp. 352.

Clark, William J. Commercial Cuba, with an Introduction by E. Sherman Gould. New York: Charles Scribner's Sons. Pp. 514 with maps. $4.

Collyer, Rev. Robert. The Parable of "Lot's Wife." Pp. 13. 5 cents.

Earl, Alfred. The Living Organism. An Introduction to the Principles of Biology. New York: The Macmillan Company. Pp 271. $1.75.

Fisher, George E., and Schwatt, Isaac J. Text-Book of Algebra, with Exercises. Philadelphia: Fisher & Schwatt. Pp. 683. $1 75.

Hall, Fred S. Sympathetic Strikes and Sympathetic Lockouts. Columbia University. (Studies in History, Economics, and Public Law.) Pp. 118.

Hill, Frank A. How far the Public High School is a Just Charge on the Public Treasury. Pp. 36.

Holman, Silas W. Matter, Energy, Force, and Work. New York: The Macmillan Company. Pp. 257. $2.

Hornbrook, A. R. Primary Arithmetic. American Book Company. Pp. 253.

Geikie, James. Rock Sculpture, or the Origin of Land Forms. New York: G. P. Putnam's Sons. Pp. 397. $2.

Hurley, Denis M. The Metric System of Weights and Measures in the Congress of the United States. Pp. 4.

Inglis, George E., Editor. The Anglo-Saxon Monthly. Chicago: The Anglo-Saxon Publishing Company. 10 cents. $1 a year.

Jackman, Wilbur S. Nature Study for Grammar Grades. Danville, Ill.: Illinois Printing Company. Pp. 407.

Jenkins, C. Francis. Animated Pictures. Washington, D. C.: C. Francis Jenkins. Pp. 118.

Jordan, David Starr. Footnotes to Evolution. New York: D. Appleton and Company. Pp. 392. $1 50.

Lassalle, Ferdinand. The Workingman's Programme. New York: International Publishing Company. Pp. 62.

Macmillan Company, The. Catalogue of Books, Section VII, Scientific, pp. 24; and Section IX, Classical and Educational, pp. 26.

Makato, Tentearo. Japanese Notions of European Political Economy. Philadelphia. Pp. 42.

Marshall, Henry Rutgers. Instinct and Reason. New York: The Macmillan Company. Pp. 575. $3.50.

Merriman, Mansfield. Elements of Sanitary Engineering. New York: John Wiley & Sons. Pp. 216

Metric System, The, of Weights and Measures. Hartford, Conn.: Hartford Steam Boiler Inspection and Insurance Company. Pp. 196.

Millennial Dawn, Vol. IV. The Day of Vengeance. Allegheny, Pa.: The Tower Publishing Company. Pp. 668. 35 cents.

Park, J. G. Language Lessons. American Book Company. Pp. 144.

Payne, Frank Owen. Geographical Nature Studies. American Book Company. Pp. 144. 25 cents.

Peabody, J. E. Laboratory Exercises in Anatomy and Physiology. New York: Henry Holt & Co. Pp. 79. 60 cents.

Preece, W. H. President's Address before the Institution of Civil Engineers, November 1, 1898. Pp. 29.

Reprints. Coulter, John M. The Origin of Gymnosperms and the Seed Habit. (Botanical Society of America.) Pp. 16.—Brinton, Daniel G. The Peoples of the Philippines. Pp. 16.—Eckles, C. H. The Relation of Certain Bacteria to the Production of Butter. Pp. 10.—Graziani, Dr. Giovanni. A Sensitive Test for Kryofine in the Urine, etc. Pp. 81.—Keen, W. W. The Advantages of a Permanent Abdominal Anus, etc., in Operations for Cancer of the Rectum. Pp. 11; The Advantages of the Trendelenburg Posture during Operations involving the Cavities of the Mouth, etc. Pp. 7; Removal of Angioma of the Liver, etc. Pp. 12.—Keen, W. W., and Spiller, W. G. On Resection of the Gasserian Ganglion, etc. Pp. 38, with plates.—Ladd, E. F. The Proteids of Cream. Pp. 3; and Humates and Soil Fertility. Pp. 7.—Lloyd, James Hendrie. A Study of the Lesions in a Case of Trauma of the Cervical Region of the Spinal Cord simulating Syringomyelia. Pp. 18.—Sherwood, W. L. The Frogs and Toads found in the Vicinity of New York City. Pp. 27.—Tromsdorff, Richard. Observations at the Clinic of Professor Ebstein on Kryofine. Pp. 12.

Ripley, Frederic H., and Tappen, Thomas. A Short Course in Music. Book Two. American Book Company. Pp. 175.

Russell, Israel C. Rivers of North America. New York: G. P. Putnam's Sons. Pp. 327. $2.

Sands, Maniel. Opposites in Religion. New York: Peter Eckler. (Library of Liberal Classics, Monthly). Pp. 138. 50 cents.

Savage, M. J. The Word of God: The Evils of Religious and Political Pessimism. Boston: George H. Ellis. Pp. 18 each.

Schimmel & Co., Leipzig and New York. Semiannual Report (fine chemicals), October, 1898. Pp. 64, with map.

Seymour, A. T., Editor. The Science Teacher. Monthly. Orange, N. J. Pp. 12. 15 cents. $1 a year.

Smithsonian Institution and United States National Museum. Annual Report of the Board of Regents to July, 1896. Pp. 727.—Bean, Barton A. Notes on a Collection of Fishes from Mexico, etc. Pp. 4.—Cook, O. F. American Oniscoid Diploda, etc. Pp. 16, with plates.—Coquillet, D. W. Report on Japanese Diptera. Pp. 36.—Enkle, Arthur. Topaz Crystals in the Mineral Collection of the Museum. Pp. 10.—Gilbert, C. N. Caulolepis Longidens, Gill, on the Coast of California. P. 1.—Jordan, David Starr, and Evermann, Barton D. The Fishes of North and Middle America. Part III. Pp. 978.—Marlatt, C. L. Japanese Hymenoptera of the Family Teuthredonidæ. Pp. 16.—Mearns, Edgar A. Mammals of the Catskill Mountains. Pp. 20.—Moore, J. Percy. The Leeches of the United States National Museum. Pp. 20, with plates.—Oberholser, Harry C. Revision of the Wrens of the Genus Thryomanes, Sclater. Pp. 30.—Rathbun, Mary J. Brachyura Collected by the Steamer Albatross between Norfolk, Va., and San Francisco. Pp. 50, with plate; and Fresh-Water Crabs of America. Pp. 30.—Smith, Hugh M. Amphiura, or the Congo Snake, in Virginia. P. 1.—Smith, John B., and Dyar, Harri on C. The Lepidopterous Family Noctuidæ of Boreal North America, etc. Pp 194, with plates.—Starks, Edwin C. Osteology and Relationships of the Family Zeidæ. Pp. 8, with plates.—Stearns, Robert E. C. A Species of Actæon from the Quaternary Deposits of Spanish Height, San Diego, Cal. Pp. 3; and Cythera (Tivala) Crassateloides, Conrad, etc. Pp. 8, with plate.—Stejneger, Leonhard. A New Species of Spiny-tailed Iguana from California. P. 1.—Test, Frederick C. Variations of the Tree Frog, Hyla Regilla. Pp. 16, with plate.—True, Frederick W. Nomenclature of the Whalebone Whales, etc. Pp. 20.—Walcott, C. D. Cambrian Brachiopoda, Obolus, and Singulella, etc. Pp. 36.

Sue, Eugène. The Silver Cross, or the Carpenter of Nazareth. New York: International Publishing Company. Pp. 151.

Sullivan, Christine Gordon. Elements of Perspective. American Book Company. Pp. 96.

Terrestrial Magnetism. An International Quarterly Journal. L. A. Bauer and Thomas French, Jr., Editors. University of Cincinnati. Pp. 46, with plates. 60 cents. $2 a year.

Vines, Sidney H. An Elementary Text-Book of Botany. New York: The Macmillan Company. Pp. 611. $2.25.

Volta Bureau, Washington, Publications of. Catalogue of Books by Prof. A. Melville Bell.—Some Differences in the Education of the Deaf and the Hearing. Pp. 15.—International Reports of Schools for the Deaf. Pp. 27.—Bell, A. G. Methods of Instructing the Deaf in the United States. Pp. 4.—Gordon, J. C. The Difference between the Two Systems of Teaching Deaf-mutes the English Language Pp. 4.—Gilman, Arthur. Miss Helen Adams Keller's First Year of College Preparatory Work. Pp. 14.—Bell, Mabel Gardiner. The Story of the Rise of the Oral Method in America as told in the Writings of the Hon. Gardiner G. Hubbard. Pp. 50.

Voorhees, Edward B. Fertilizers. New York: The Macmillan Company. Pp. 335. $1.

Wadden Turner, Susan, Prof. William, and Jane. In Memoriam. By Caroline H. Dall. Pp. 19.

Weysse, Arthur W. An Epitome of Human Histology. New York: Longmans, Green & Co. Pp. 90. $1.50.

Fragments of Science.

The Huxley Lecture.—The Charing Cross Medical School in London, which had the good fortune some fifty-three years ago to number Huxley among its pupils, had largely through this fact the honor of being addressed on October 3d by Professor Virchow, the greatest living pathologist and one of the greatest of living scientists. There was a peculiar fitness in his delivering the Huxley lecture, for, while Professor Virchow's work has been chiefly that of the specialist, his co-operation with laborers in other fields, his continued efforts to popularize science, and the prominent position which he has occupied for the last thirty years in public life, have given him a standing in Germany somewhat akin to that of Huxley in England. His career is a striking illustration, as was also Huxley's, of the happy results to humanity from a combination in one man of great ability as an investigator with a facility for generalization and the practical application of scientific truths to the concrete problems of science and civilization. Professor Virchow is described as modest and unassuming, and very much of a contrast in all ways to the ordinary German professor. His address was on The Recent Advances in Science, and their Bearing on Medicine and Surgery. It was inevitable that he should refer to Huxley, of whom he was in some sense a pupil. In speaking of the rapid growth of the latter during his four years on the Beagle, he said: "How this was possible any one will readily understand who knows from his own experience how great is the value of personal observation. . . . Freed from the formalism of the schools, thrown upon his own intellect, compelled to test each single object as regards properties and history, we soon forget the dogmas of the prevailing system, and become first a skeptic and then an investigator." This paragraph is especially worthy of notice, because it points out one of the invariable characteristics of the great man. In whatever field his greatness may lie, he will be found to have broken away from the formalism and conservatism of the schools, and that his great work is based on personal observation and research. This was notably the case with Professor Virchow's establishment of the cellular pathology, as well as of Huxley's researches in comparative anatomy. Our present school system is lamentably weak in this particular, tending to stifle rather than stimulate originality and self-dependence. Professor Virchow's address was, of course, interesting and instructive, but, as he said, much too short for anything like an adequate treatment of the subject. The chief interest of the occasion lay in its associations. An address by Rudolph Virchow, at a meeting presided over by Lord Lister on an occasion commemorating Professor Huxley, left only one thing to be desired—the presence of the latter. For a biologist, or in fact a modern scientist of any description, one can not imagine a more delightful occasion.

The Climate of Cuba.—Systematic records of weather appear to be wanting in Cuba. The meteorological observations kept up for several years by Andre Poey are not accessible, no need of their being published having been found. The chief source of information on the subject is the observations which have been kept up at Belen College, Havana, since 1859. From these and a few scattered observations of brief periods at other towns, and by comparison with notes taken at other West Indian stations, W. F. B. Phillips, of the United States Department of Agriculture, has attempted to describe the climate of Cuba. The average annual temperature of the past ten years at Havana was 77° F., and the difference between the highest and the lowest yearly means was only 1.1° F. The warmest month is July, with an average temperature of 82.7° F., and the coldest is January, with an average temperature of 70.3° F. The highest temperature recorded was 100.6° F., in July, 1891, and the lowest 49.6°. Brief intermittent records at Matanzas, more than sixty years old, give a mean annual temperature of about 78°, with 93° as the highest and 51° as the lowest. At Santiago the annual mean appears to be about 80°, and the difference between the warmest and coldest months about 6° F. Records of temperature in the interior, such as they are, give annual means of from 73.6° to 75°, apparently showing lower temperatures than on the coast. The average daily range of temperature is about 10°, the highest occurring between noon and two o'clock P. M., while sudden variations in the temperature of the day are not unknown. The average yearly rainfall at Havana is about fifty-two inches. The season of heavy rainfall begins in the latter part of May and first of June, and lasts till October, and during this period about sixty-three per cent of the year's rain is precipitated. Rain occurs on about one day in three, in heavy downpours of short duration. Notwithstanding the frequency of rain during the summer months, these do not present the greatest number of cloudy days. The days on which rain does not fall are usually perfectly cloudless, and, in general, no clouds are seen in summer except while the showers are falling; while in other months cloudy days sometimes occur without rain. The average velocity of the wind is about 7.5 miles an hour, with variations, according to the season, from 8.5 miles in winter to 6.5 miles in summer. The diurnal variation in wind velocity is much more pronounced than the seasonal variation.

The New Planet D Q.—The number of minor planets discovered during the last few years, and their lack of practical importance in astronomy, has tended to distract astronomers' attention from the search for them, as unprofitable, and the announcement of a new one attracts little attention, as a rule. The planet D Q, however, discovered by Herr Witt, of the Urania Observatory, of Berlin, on August 13th last, has aroused from the first special attention through its remarkable behavior. The orbit is a very unusual one. Mars has always been considered our nearest neighbor, although it was known that some of the minor planets were slightly nearer to the sun when at perihelion than Mars is when at aphelion. But the mean distances of the latter were in all cases much greater than that of Mars; while that found for the new planet is only 1.46 as compared with 1.52 for Mars, and, as the eccentricity amounts to 0.23, the perihelion distance is only 1.13, and the least distance from the earth's orbit only 0.15 as compared with 0.27 for Venus in transit, and 0.38 for Mars in perihelion. The planet will thus be far closer to us than any other member of the solar system, and will afford a most excellent means of determining the sun's parallax. Its diameter is thought to be about seventeen miles.

Extra-Organic Factors of Evolution.—Observing that our civilization has made advances or "strides" in recent years out of all proportion to any improvements that have taken place in our organic faculties, Arthur Allin has insisted, in Science, on the importance of extra-organic factors in human development. Our sense and motor organs, he says, are essentially instruments and tools, and so is the brain; and most if not all of the three hundred or more mechanical movements known in the arts are found exemplified in the human body. Our sense organs are thus indefinitely multiplied and extended by such extra-organic sense organs as the microscope, telescope, resonator, telephone, telegraph, thermometer, etc. Our motor organs are multiplied by such agencies as steam and electrical machines, etc., in the same manner. "The printing press is an extra-organic memory far more lasting and durable than the plastic but fickle brain. Fire provides man with a second digestive apparatus by means of which hard and stringy roots and other materials for food are rendered digestible and poisonous roots and herbs innocuous. Tools, traps, weapons, etc., are but extensions of bodily contrivances. Clothing, unlike the fur or layer of blubber of the lower animals, becomes a part of the organism at will. One finds himself more or less independent of seasons, climates, and geographical restrictions. By organic heredity or the transmission of the congenital characteristics of the parents to the children, working alone, all progress depends upon the transmission of variations occurring within the organism. "Moreover, these advantageous organic variations die with the individual, and must be born again, so to speak, with each new individual." This requires time, and progress depending on it would be indefinitely protracted. On the other hand, by means of social heredity, each new member of the race has handed to him at birth the accumulated organic advantageous variations of sense and motor organs, and the extra-organic adaptations that have multiplied so indefinitely in the age of civilized man. "The vast importance of accumulation of capital is obvious."

Fossils as Criterions of Geological Ages.—Prof. O. C. Marsh said in a paper on The Comparative Value of Different Kinds of Fossils in determining Geological Age, which was read at the meeting of the British Association, that the value of all fossils as evidence of geological age depends mainly upon their degree of specialization. In invertebrates, for example, a lingula from the Cambrian has reached a definite point of development from some earlier ancestor. One from the Silurian or Devonian, or even a later formation, shows, however, little advance. Even recent forms of the same or an allied genus have no distinctive characters sufficiently important to mark geological horizons. With ammonites the case is entirely different. From the earliest appearance of the family the members were constantly changing. The trilobites show a group of invertebrates ever subject to modification, from the earliest known forms in the Cambrian to the last survivors in the Permian. They are thus especially fitted to aid the geologist, as each has distinctive features and an abiding place of its own in geological time. In the fresh-water forms of mollusca—the Unios, for example—there is little evidence of change from the palæozoic forms to those still living, and we can therefore expect little assistance from them in noticing the succeeding periods during their life history. The same law as to specialization holds good among the fossil vertebrates.

Pedigree Photographs.—Sir Francis Galton unfolded before the British Association a plan for the systematic collection of photographs of pedigree stock, particularly of cattle breeds, and of more information about them than is now obtainable. He believes that a system of this sort would greatly facilitate the study of heredity. The author had previously shown how the general knowledge that offspring can inherit peculiarities from their ancestry as well as from their parents was superseded by a general law the nature of which was first suggested to him by theoretical considerations, and this ancestral law proves the importance of a much more comprehensive system of records than now exists. The breeder should be able to compare the records of all the near ancestry of the animals he proposes to mate in respect to the qualities in which he is interested. No present source for such information is comparable with what the system proposed would furnish. A habitual study of the form of each pure-bred animal in connection with the portraits of all its nearest ancestry would test current opinions and decide between conflicting ones, and could not fail to suggest new ideas. Likenesses would be traced to prepotent ancestors, and the amount of their several prepotencies would be defined; forms and features that supplement one another or "nick in," and others that clash or combine awkwardly, would be observed and recorded; and conclusions based on incomplete and inaccurate memories of ancestry would give way to others founded on more exact data. The value of the ancestral law would be adequately tested, and it would be possible to amend it when required.

English Names for Plants.—In the Proceedings of the Torrey Botanical Club, published in its journal for July, Dr. V. Havard suggested some principles which it would be well to follow in applying English names to plants, predicating that an authorized vernacular binomial should be assigned to each plant, so that ambiguity and confusion may be avoided. In the absence of suitable English names already recognized, it seems best to adopt the Latin genus name, if short and easy, like *Cicuta*, *Parnassia*, *Hibiscus*, or a close translation thereof, when possible, like astragal, chenopody, cardamin, while the specific English name should be an equivalent of the Latin one or a descriptive adjective. In case of all English binomials clearly applying to well-known individual species and no others, all substantives are capitalized without a hyphen, as in Witch Hazel, May Apple, and Dutchman's Pipe. In all genera in which two or more species must be designated, the genus name is compounded into one word without a hyphen, as Peppergrass, Sweetbrier, Goldenrod, Hedgenettle, etc.; except in long names, where the eye requires the hyphen, as Prairie-clover, Forget-me-not. Genus names in the possessive case (St. John's-wort) are written with the hyphen, followed by a lower-case initial. Plants commemorating individual men (Douglas Spruce, Coulter Pine) are written without the mark of the possessive. In specific names participial endings are suppressed, the participle becoming a substantive, which is added as a suffix without the hyphen; thus Heartleaved Willow is changed to Heartleaf Willow. In the discussion that followed this paper, President Addison Brown and Dr. T. F. Allen deprecated the manufacture of book names. The secretary defended the use of vernacular names, saying that they deserved more attention, and adding that in their absence the generic name should be used unchanged. Many Latin names, as *Portulacca*, win their way without change as soon as they are fairly made familiar. "Coined names seldom live. A name to be successful must be a growth, as language is."

Cooking Schools in Philadelphia.—The establishment of schools in Philadelphia for the teaching of cookery is mentioned, in the Annual Report of the Superintendent of Public Schools in that city, among the results of the general movement for manual training, as a means of mental development and practical knowledge. The teaching was introduced experimentally into the Girls' Normal School in 1887, and was in the following year made a regular branch of the course. It was later extended to other schools. There are now eight school kitchens under the department of Public Instruction, situated in different parts of the city. The question of the proper place for cookery in the school course has been solved, for Philadelphia, by putting it in the sixth school year, when the pupils are firmly established in the work of the grammar grades, and their attention has not yet been directed to preparation for admission to the High School. The course provides between twenty-five and thirty lessons, and is completed in a single year. It includes instruction in the care of the kitchen, and of the stove or range, general lessons in the classification and nutritive values of foods, the cooking of vegetables, breakfast cereals, bread, eggs, soups, meats, simple cakes and desserts, lessons in invalid cookery, and in table setting and serving. Special attention is given to the preparation of nutritious and savory dishes from inexpensive materials. About two thousand pupils, or less than one half of the number of girls of the sixth year now in the schools, are accommodated in the eight cookery schools. The pupils manifest an intelligent interest in the instruction, and spend the half day per week in the school kitchen without any appreciable loss in the other branches of study. "It comes as a period of relaxation."

A Trait Common to us All.—The doctrine of the tendency of mankind to develop the like fancies and ideas at the like stage of intellectual infancy was mentioned by Mr. E. W. Brabrook in his presidential address before the Anthropological Section of the British Association, as a generalization for which we are fast accumulating material in folklore. It is akin to the generalization that individual savage races present in their intellectual development a marked analogy to the condition of the earlier races of mankind. The fancies and ideas of the child resemble closely the fancies and ideas of the savage and the fancies and ideas of primitive man. Mrs. Gomme has found that a great number of children's games consist of dramatic representations of marriage by capture and marriage by purchase, and that the idea of exogamy is distinctly embodied in them. There can be little doubt that they go back to a high antiquity, and there is much probability that they are founded upon customs actually existing, or just passing away, at the time they were first played. Upon the same principle, if we view children's stories in their wealth of details, we shall deem it impossible that they could have been disseminated over the world otherwise than by actual contact of the several peoples with each other. But if we view them in their simplicity of idea, we shall be more apt to think that the mind of man naturally produces the same result under like circumstances, and that it is not necessary to postulate any communication between the peoples to account for their identity. It does not surprise us that the same complicated physical operations should be performed by far-distant peoples without any communication with each other; why should it be surprising that mental operations, not nearly so complex, should be produced in the same order by different peoples without any such communication?

The Toes in Walking.—An instructive discussion of the walking value of the lesser toes by Dr. Heather Bigg is given in a recent copy of the London Lancet. Dr. Bigg believes that the lesser toes of the human foot are of little importance in walking—the great toe constituting the important tread of the foot—and in proof of this he gives an account of a patient, all of whose lesser toes it was found necessary to amputate because of persistent contraction of the tendons. On November 10, 1894, the toes were removed, especial care being taken to keep the resulting scars well up on the dorsal aspect of the foot, so as to be well away from the subsequent tread. In three weeks the patient could stand on her feet, and, after her return home, sent the following record of her progress toward complete recovery: December 30, 1894: "I am able to walk perfectly on my feet with little or no pain, but can not yet wear either slippers or boots, as they are still tender."—January 15, 1895: "I managed to get on my slippers yesterday and wore them with ease for more than six hours."—January 28th: "I put on my boots to-day for the first time. It still pains me slightly to walk; otherwise my feet are going on all right."—February 18th: "I ought to say that the steel plates only half way answer splendidly."—March 24th: "You will be glad to hear that I can walk splendidly now, just like a proper human being; it is just eighteen weeks next Tuesday since the operation."—May 5th: "I have decided to come to town next Monday week to let you see how well I can walk."—June 17th: "I played two sets of tennis on Saturday, and my feet were none the worse afterward."—July 24th: "You will be surprised to hear that the big toes have lengthened half an inch since the operation, and I have had all my boots lengthened and the toe line made straighter."—August 30th: "I know that you will be interested to hear that I have just accepted an invitation to a dance on September 13th. Whether I shall dance comfortably or not is another thing."—September 14th: "I went to the dance on Tuesday evening and thoroughly enjoyed myself after not dancing for so long. My feet were on their best behavior, and did not pain me once during the evening. I never realized before that I had no toes until I began to dance; then it seemed so odd only to have one toe, but I suffered no inconvenience whatever from the loss of them."—December 5th: "I get on so well with my bicycle." Only two disadvantages showed themselves as the result of the operation and these were temporary. One was that the great toes tended to pervert themselves toward the middle line of the feet, a thing which was readily remedied by the use of single-toed stockings, and by packing the space in the boot left vacant by the missing toes with cotton wool; the other was a loss of local sense on the outer sides of the feet, which went to show that the lesser toes were missed rather as tactile organs than anything else. This failure of feeling righted itself in time, presumably by a vicarious and intenser sense being acquired by the skin of the outer side of the foot. In all other respects the loss of the toes discovered no inconvenience.

Animals' Bites.—That there is something more serious than the mere wound in the bite even of a healthy animal is attested by Mr. Pagin Thornton, from a chapter in his own experience, and in the testimony of a number of his own friends who have suffered for weeks together from having been bitten. "And what is more surprising to me," he says, "is that some of us may have hands crippled for some time from bites of a man's teeth." Dog bites are always dangerous, but largely from the size of the wound which a dog biting in earnest will inflict. With men they usually fail to do their best. Animals recover from wounds more easily than men do; but Lord Ebrington says that deer bitten by the dogs in Exmoor hardly ever recover. Much of the poisoning caused by bites is supposed to be due to the state of the animal's teeth; and in this way the bite of a herbivorous animal, whose teeth are usually soiled, may cause worse after effects than that of a carnivore, whose wet mouth and wet tongue keep its teeth fairly clean. A similar difference is observable in the effects of being clawed and bitten by carnivora. Wounds made by the claws of leopards are poisonous, while those caused by the teeth are rarely septic. The force with which a bite in earnest is inflicted is an important element in its dangerous character. "It seems," says the London Spectator, "as if for the moment the animal threw all its force into the combination of muscular action which we call a 'bite.' In most cases the mere shock of impact, as the beast hurls itself on its enemy, is entirely demoralizing, or inflicts physical injury. A muzzled mastiff will hurl a man to the ground in the effort to fasten its teeth in his throat or shoulder. Then, the driving and crushing force of the jaw muscles is astonishing." Sir Samuel Baker noticed that the tiger usually seized an Indian native by the shoulder, and with one jaw on one side and the other on the other bit clean through chest and back. In nearly all cases the bite penetrates to the lungs. This kind of wound is characteristic of the bites of the *felidæ*. Hardly any bird recovers from a cat's bite, for the same reason. The canine teeth are almost instantly driven through the lung under the wing.

Doulton Potteries.—Sir Henry Doulton, head of the Lambeth potteries, whose death, November 17, 1897, has been recorded in the Monthly, preferred devoting himself to the factory to engaging in the study of a learned profession for which his parents intended him, and himself did much of the largest work produced there in the earlier days of his connection with it. As the factory was enlarged, it made drain pipes, vessels and appliances of stoneware for chemical and other similar uses, for which it gained prizes at the great exhibitions of 1851 and 1862;

ale pots and mugs of traditional and original designs; terra-cotta vases; and first exhibited articles of higher artistic merit at Paris in 1867. It showed a magnificent collection at Vienna in 1873, and its exhibit at Philadelphia in 1876 was one of the marked features of our Centennial. The chief styles of its work are the ornamental salt-glazed stoneware known as Doulton ware, and the underglaze-painted earthenware called "Lambeth faïence." Sir George Birdwood ascribes as the great merit of Sir Henry's life work his adherence to the two principles of making, as far as possible, every piece intended for decoration on the wheel, and of giving the utmost scope to the designer into whose hands the piece fell for ornamentation. Four hundred designers, mostly women, and some of them real artists, are engaged at the potteries, and each has her way and signs her name to her work; so that "Sir Henry Doulton succeeded in creating a most prolific school, or rather several schools, of English pottery, the influence of which has been felt in the revival of the ceramic arts in all the countries of the Old World"—where they had been demoralized by the use of machinery; and through the influence of his example, working since 1871, the United Kingdom now produces "the most artistic commercial pottery of any country in the world."

MINOR PARAGRAPHS.

A LITTLE over a year ago Professor Fraser published the results of some researches which showed that the bile of several animals possessed antidotal properties against serpents' venom, and against the toxines of such diseases as diphtheria and tetanus, and that the bile of venomous serpents is an antidote to their venom. The results from an extension of these first experiments have been recently published in the British Medical Journal. The most important conclusions are as follows: The bile of venomous serpents is the most powerful antidote to venom, and is closely followed in efficiency by the bile of innocuous serpents. Regarding the antidotal power of bile on the toxines of disease, Professor Fraser found that the bile of venomous serpents had more antidotal power than that of the majority of the other animals examined. It is curious that among the non-venomous animals the rabbit's bile is the most powerful in antidotal properties.

THREE ways are mentioned by Prof. W. A. Herdman in which disease may be communicated through oysters to the consumer; viz., by the presence in the animal of inorganic, usually metallic, poison; or of organic poison; or of a pathological organism or definite disease germ. From experiments in the inoculation and disinfection of oysters, it was found that all traces of these organisms could be removed by proper washing. Good currents passing the beds are an important factor in keeping the oyster healthy, and make it possible for the animal to absorb large quantities of sewage and dispose of it. The effect of this is to purify the water; but in the sifting process, while the sewage is passing through, the animal retains disease germs, and may pass them on to the consumer. Oysters should therefore be given an opportunity to purify themselves, as is done in France, where they are kept for a time in clean tanks before being sent to market. Oysters may be effectively washed in fresh water. Sea water is unfavorable to disease germs. Greenness in oysters is caused by food administered to improve their quality; by the presence of copper; and in some American oysters by an inflamed condition of the mantle. Green spots are also produced by wandering cells getting under the epithelium. These cells are loaded with granules which give a copper reaction.

THE most interesting result of the massacre and sack of Benin, the Saturday Review says, was the capture of a large series of brass plaques, statuettes, box lids, pipes, etc., which have been brought to England. The various articles are all castings, and their elaborate ornamentation bespeaks for their makers great skill in metal working. Most African tribes have smiths who hammer pieces of brass rod and wire into simple ornaments; but these Benin brasses represent a stage of metal working far more advanced than anything recorded for the native races of Africa. Nothing like them is being made by any negro race at present, and nothing is known that can be regarded as a precursor of them. A statuette in the Liverpool Museum of a negro holding a flint gun fixes their date as not earlier than about 1630. In trying to account for them, many think they were due to the influence of some comparatively advanced tribe that reached Benin from the central Soudan and brought with them a knowledge of brass work derived from early, possibly Egyptian, sources; and others attribute the work to some prisoner or trader who lived at Benin in the seventeenth century.

NOTES.

The Committee of the British Association on Meteorological Photography reported that the result of their determinations of the heights of clouds showed the existence of greater altitudes in hot weather under thunderstorm conditions, when clouds may occur at five or six different levels, extending as high as ninety thousand feet. A rise of cloud takes place in hot weather, also during the morning and early afternoons, while the lowest altitudes are found during cyclones.

M. Maige, by varying the condition of exposure of plants to light, and keeping flowering branches in the dark, has succeeded in transforming the latter into sterile creeping or climbing branches. Inversely, he has been able, by means of the localized action of light, to transform creeping or climbing into flowering branches These results were obtained at the vegetable biological laboratory of Fontainebleau.

F. L. Washburn, of the State University of Oregon, reports that the condition of the Eastern oysters introduced to the Oregon coast waters two years ago leaves nothing to be desired. The specimens have withstood two winters successfully, and have made phenomenal growth, "far exceeding what they would have made in the same time in their native waters. Further, they spawned." The experiments in artificial fertilization were not so successful. The spawn suffer from the serious difficulties of sudden variations in the temperature and salinity of the water resulting from the change of tide and strong winds. It is hoped that better conditions may be found at Yaquina Bay.

The population of Egypt has been gradually increasing during the past hundred years. It is stated to have been about two and a half million in 1800, and is now estimated at nearly ten million. There are about 112,000 foreigners, of whom 38,000 are Greeks; the remainder being chiefly Italians, 24,000; English, 19,000; French, 14,000; Austrians, 7,000; Russians, 3,000; and Persians and Germans, about 1,000 each. Only about five per cent of the population can read and write, and nearly two thirds are without any trade or profession.

Our record of deaths among men known in science includes the names of Dr. Henriques de Castro, a Dutch archæologist of Portuguese descent, member of many learned societies of the Netherlands; John Eliza de Vry, of the Netherlands, one of the chief authorities on the chemistry and pharmacy of the cinchona alkaloids, at The Hague, July 30th, in the eighty-sixth year of his age; Dr. Eugenio Bettoni, director of the Fisheries Station at Brescia, Italy, August 5th, aged fifty-three years; Professor Arzruni, mineralogist in the Polytechnic Institute at Aix; Heinrich Theodor Richter, director of the School of Mines at Freiburg, Saxony; Dr. J. Crocq, professor of pathology in the University of Brussels; Dr. C. G. Gibelli, professor of botany and director of the Botanical Institute at Turin; Don Francisco Coello de Portugal, president of the Geographical Society of Madrid, and author of an atlas of Spain and its colonies; Dr. B. Kotula, author of Researches on the Distribution of Plants; Surgeon Major J. E. T. Aitchison, a distinguished botanist, particularly in the botany of India, and author of numerous papers on the subject, September 30th, in his sixty-fourth year; M. Thomas Frédéric Moreau, a French archæologist, author of a collection of Gallic, Gallo-Roman, and Merovingian antiquities, in his one hundred and first year; M. Gabriel de Mortillet, the eminent French anthropologist, in Paris, November 4th, aged sixty-seven years; Sir George Smyth Baden Powell, political economist, aged fifty-one years; Sir John Fowler, engineer in chief of the Forth Bridge, aged eighty-one years; Dr. James I. Peck, assistant professor of biology in Williams College, and assistant director of the Biological Laboratory at Woods Hole; George Vestal, professor of agriculture and horticulture at the New Mexico Agricultural College, October 24th, aged forty-one years; Dr. W. Kochs, docent for physiology at Bonn; M. J. V. Barbier, a distinguished French geographer; M. N. J. Raffard, an eminent French mechanical engineer, author of many valuable inventions; Latimer Clark, F. R. S., an eminent English electrician, one of the founders and a past president of the Institution of Electrical Engineers, whose name is associated with the history of electric telegraphy and with many inventions, and author of several books that are standard with the profession, at Kensington, London, October 30th, in his seventy-sixth year; Count Michele Stefano de Rossi, a distinguished Italian seismologist; M. de Meritens, a French electrical engineer, inventor of one of the first practical dynamos, and of other valuable electrical apparatus, aged sixty-five years.

GABRIEL DE MORTILLET.

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VEGETATION A REMEDY FOR THE SUMMER HEAT OF CITIES.

A PLEA FOR THE CULTIVATION OF TREES, SHRUBS, PLANTS, VINES, AND GRASSES IN THE STREETS OF NEW YORK FOR THE IMPROVEMENT OF THE PUBLIC HEALTH, FOR THE COMFORT OF SUMMER RESIDENTS, AND FOR ORNAMENTATION.*

By STEPHEN SMITH, M. D., LL. D.

ONE of the most prolific sources of a high sickness and death rate in the city of New York is developed during the summer quarter. It has been estimated that from three to five thousand persons die and sixty to one hundred thousand cases of sickness occur annually in this city, from causes which are engendered during the months of June, July, August, and September. An examination of the records of the Health Department for any year reveals the important fact that certain diseases are not only more frequent during the summer quarter than at any other time, but that they are far

* In 1872, while a Commissioner of Health, I had occasion to examine and report on the causes of the high death rate during the summer months in the city of New York. The chief cause was determined to be the excessive heat which characterizes those months. It was recommended in the report to the Board of Health that legislation be secured empowering and requiring the Department of Parks to plant and cultivate trees, shrubs, plants, and vines in all the streets, avenues, and public places in the city. A bill was drafted and introduced into the Legislature, but it did not become a law, and no further effort has been made to secure such legislation. Meantime, two tree-planting societies have been established, one in the Borough of Brooklyn and the other in the Borough of Manhattan, which are endeavoring to awaken public interest to the importance of planting a suitable number and variety of trees in the streets for purposes of ornamentation. The aim of this paper, which is largely based on the report of 1872, is to revive the project of giving the Department of Parks jurisdiction over the trees in the streets, and require it to plant and cultivate additional trees, shrubs, plants, and other forms of vegetation for the improvement of the public health and for the purpose of ornamentation.

more fatal, especially in the months of July and August, than during any other period of the year. These are the "zymotic diseases," or those depending upon some form of germ life. The following table illustrates the course of mortality from those diseases in one year:

Month.	Deaths.	Month.	Deaths.
January	541	July	1,433
February	475	August	1,126
March	476	September	791
April	554	October	522
May	584	November	460
June	798	December	504

It appears that during eight months of the year, excluding June, July, August, and September, the average monthly mortality from "zymotic diseases" was 452. Had the same average continued during the remaining four months the total mortality from those diseases for that year would have been 4,424; but the actual mortality was 7,764, which proves that 3,340 persons were sacrificed during those four fatal months to conditions which exist in the city only at that period of the year. Still more startling is the estimate of the sickness rate caused by the unhealthful conditions created in the summer months in New York city. If we estimate that there are twenty cases of sickness for every death by a zymotic disease there were 66,800 more cases of sickness in the year above referred to than there would have been had the sickness rate been the same in the summer as in the other months of that year.

One of the saddest features of this high sickness and death rate appears when we notice the ages of those who are especially the victims of these fatal diseases. During the week ending July 9th last there were 399 deaths from diarrhœal diseases, of which number 382 were children under five years of age. The following table taken from the records of the Health Department show in a very striking manner how fatal to child life are the conditions peculiar to our summer season:

Month.	Deaths from diarrhœal diseases.			
	Under one year.	Under two years.	Under five years.	All ages.
January	50	55	58	82
February	47	51	58	75
March	75	80	83	96
April	82	91	97	108
May	101	117	121	104
June	387	430	436	467
July	809	990	1,020	1,100
August	464	565	697	762
September	267	394	409	462
October	114	148	154	190
November	59	70	72	89
December	57	62	64	82

These statistics demonstrate the extreme unhealthfulness of New York during the summer, and the vast proportion of children who perish from the fatal agencies which are then brought into activity. It is a matter of great public concern to determine the nature of the unhygienic conditions on which this excessive mortality depends, and thus discover the proper remedial measures.

As high temperature is the distinguishing feature of the summer months, we very naturally conclude that excessive heat is a most important factor, if not the sole cause, of the diseases so fatal to human life at this period. A close comparison of the temperature and mortality records of any summer in this city demonstrates the direct re-

Week ending	Total diarrhœal diseases.	Diarrhœal diseases under five yrs.	Mean temperature (Fahrenheit).	Maximum temperature (Fahrenheit).	Minimum temperature (Fahrenheit).
May 7th	10	8	52.4°	72°	47°
May 14th	20	17	55.5°	71°	40°
May 21st	14	12	63.3°	86°	52°
May 28th	22	19	60.9°	70°	56°
June 4th	18	16	65.8°	76°	54°
June 11th	26	20	71.6°	86°	58°
June 18th	36	32	73.0°	89°	59°
June 25th	74	69	69.3°	94°	54°
July 2d	170	164	78.6°	94°	67°
July 9th	399	382	77.4°	100°	61°
July 16th	330	321	71.1°	91°	57°
July 23d	388	356	77.4°	91°	67°
July 30th	380	353	78.5°	95°	70°
August 6th	380	353	78.8°	92°	67°
August 13th	342	306	73.9°	90°	65°
August 20th	290	261	74.8°	89°	64°
August 27th	268	246	76.6°	93°	63°
September 3d	289	256	79.0°	93°	59°
September 10th	283	255	74.0°	92°	58°
September 17th	179	158	67.3°	85°	52°
September 24th	193	167	68.7°	90°	52°
October 1st	132	117	66.5°	80°	54°
October 8th	90	78	69.6°	81°	53°
October 15th	71	58	60.1°	74°	49°
October 22d	54	42	55.9°	71°	44°
October 29th	39	32	53.9°	67°	41°

lation of the former to the latter. For illustration, we will take the records of the Health Department during the past summer, selecting diarrhœal diseases for comparison, as they prevail and are most fatal at that season of the year. The table gives the total mortality from these diseases and the mortality from those diseases of children under five years of age. To the four months, June, July, August, and September, are added May and October, for the purpose of showing the gradual increase of the mortality from these diseases as the hot weather approaches and its decline as the hot weather abates.

Again, if we compare the temperature and mortality records for a series of days instead of months, it will be noticed that the mortality record follows the fluctuations of the heat record with as much precision as effect follows cause. The summer heat generally begins about the 20th of June and continues with varying intensity until the 15th of September. Within that period we can select many examples which strikingly illustrate the relations of temperature to mortality. For example, the first heated term of the year before us began on the 19th of June and lasted until the 26th of that month. The two records are as follows:

Day.	Temperature.	Mortality.
19th	78°	83
20th	80	100
21st	82	122
22d	80	116
23d	77	104
24th	68	119
25th	65	88

On the 28th of June a second heated term began, when the temperature rose to 80°, and continued above that figure until July 5th, a period of eight days. The following is the record, including the temperature in the sun:

Day.	Temperature		
	In shade.	In sun.	Mortality.
June 28th	80°	118°	118
June 29th	84	120	163
June 30th	85	124	191
July 1st	88	125	247
July 2d	87	128	351
July 3d	82	120	238
July 4th	84	122	227
July 5th	80	121	184

It will be noticed that during the last heated period there was a more prolonged high temperature than during the first, and that the mortality of the second was higher for the same temperature than that of the first. These facts are in accord with the history of our summer months. The range of temperature increases as the season advances, and the rate of mortality rises, owing to the diminished resisting power to the effects of high heat on the part of the people, especially of the children, the aged, and those already enfeebled by disease.

In order to fully understand the influence of heat and its effects upon the public health, we must first notice the conditions regulating the temperature of the body in health and disease.

The temperature of animals in a state of health is not a fixed quantity, but has a limited range which depends upon internal and external conditions not incompatible with health. In man the range of temperature in health is fixed at 97.25° F. to 99.5° F. Any temperature above or below these extremes, unless explained by special circumstances not affecting the normal condition of the person, is an indication of disease. This comparatively fixed temperature in health is a remarkable feature of the living animal. When subjected to a temperature above or below the extremes here given it will still maintain its equilibrium. This fixed temperature under varying conditions of heat and cold is due to a "heat-regulating power," inherent in the constitution of every animal, by which it imparts heat when the temperature of the air is high and conserves heat when the latter is low. The heat escapes from the body—1, by radiation from the surface; 2, by transmission to other bodies; 3, by evaporation; and 4, by the conversion of heat into motion. The surface of the body furnishes the principal medium for the loss of heat by the first three methods—viz., radiation, transmission, and evaporation. It is estimated that 93.07 per cent of the heat produced escapes by the processes of radiation, evaporation, conduction, and mechanical work. The remaining heat units are lost by warming inspired air and the foods and drinks taken. There are apparently other subtile influences, so-called "regulators of heat," at work to preserve an equilibrium of temperature in the animal body, but they are not well known. The result of the operation of these forces is this—viz., if, by any means, the heat of the body is increased, compensative losses of heat quickly occur, and the normal temperature is soon restored; and if, on the contrary, the loss of heat is unusually increased, the compensative production of heat of the body at once follows, and the equilibrium is at once restored. The important fact to remember is this—viz., the production and loss of heat in the human organism when in health and not subjected to too violent disturbing causes are so nicely balanced that the temperature is always maintained at an average of 98.6° F., the extremes being 97.25° F. and 99.5° F. "So beautifully is this balance preserved," Parkes remarks, "that the stability of the animal temperature in all countries has always been a subject of marvel." If, however, anything prevents the operation of the processes of cooling—viz., radiation, evaporation, and conduction—the bodily temperature rises by the accumulation of heat, and death is the result from combustion. In experiments in ovens a man has been able to bear a temperature of 260° F. for a short period, provided the air was dry so that evaporation could be carried on rapidly. But if the air is very moist, and perspiration is impeded, the temperature of the body rises rapidly, and the person soon succumbs to the excessive heat. Another important fact is this, viz., the normal temperature of the young and of the very old is higher than the middle-aged. The infant at birth has a temperature of 99° F. to 100° F., and it maintains a temperature of 99° F. and upward for several days. The variations of temperature from other causes are much greater in children than in adults, as also the normal daily variations of temperature. About the sixtieth year the average temperature of man begins to rise, and approximates that of the infant. In the young and old the "heat-regulating power" is more readily exhausted, and hence continued high temperature is far more fatal to these classes.

The first noticeable fact in regard to bodily temperature in disease is that there are daily fluctuations as in health, but much more extreme. In general, the remission of temperature in disease occurs in the morning, and the exacerbation in the afternoon and evening; the minimum is reached between six and nine o'clock in the morning, and the maximum between three and six o'clock in the evening. In many diseases the minimum temperature is not below 100° F., and usually it is one or two degrees above that point, while the maximum has no definite limit and may reach the dangerous height of 107° F. It should be noticed that the highest daily temperature in disease, as in health, occurs in the afternoon, when the temperature of the air in summer is the greatest.

The conditions affecting the temperature of the body other than those due to physiological conditions are very numerous. First and most obvious is the temperature of the surrounding atmosphere. It is a well-established fact that an average temperature of the air of 54° F. is best adapted to the public health, for at that temperature the decomposition of animal and vegetable matter is slight, and normal temperature is most easily maintained. Every degree of temperature above or below that point requires a more or less effort of the heat-regulating power to maintain the proper equilibrium. Even more potent in elevating the bodily temperature is the introduction into the blood, whether by respiration or by direct injection, of putrid fluids and the gases of decomposing matters. If this injection is repeated at short intervals, death will occur with a high temperature. The air of cities contains emanations, in hot weather, from a vast number of sources of animal and vegetable decomposition, and the inhalation of air so vitiated brings in contact with the blood these deleterious products in a highly divided state which cause a fatal elevation of temperature in the young, old, and enfeebled. The same effect is produced by the air in close and heated places, as in tenement houses, workshops, schoolhouses, hospital wards, and other rooms where many persons congregate for hours. Air thus charged with poisonous gases becomes more dangerous if the temperature of the place is raised, as happens almost daily in the summer months in cities.

From the preceding facts we may conclude that, as long as the body continues in health, the "heat-regulating power," which constantly tends to preserve an equilibrium of temperature, is capable of resisting the ordinary agencies that, operating externally or internally, exaggerate the heat-producing conditions, and thus destroy the individual. But if the person is suffering from a disease which weakens the "heat-regulating power" these deleterious agencies, which the healthy person may resist, will readily overpower the already quite exhausted heat-regulating forces, and he perishes by combustion. It is very evident that in an organism having complicated functions, like that of man, and subject to such a multitude of adverse influences, the balance between health and disease must be very nicely adjusted. Too great an elevation or too great a depression of temperature may destroy the "heat-regulating power," and disease or death will be the consequence. Or this "heat-regulating power" may be weakened or destroyed by causes generated within the body, or received from without, and the heat-producing agencies are then under influences which may prove to be powerfully destructive forces.

It will not now be difficult to understand in what manner high temperature affects the public health of large cities. Evidently in the *direct* action of heat upon the human body we have the most powerful agency in the production of our great summer mortality. While sunstroke represents the maximum direct effect of solar heat upon the human subject, the large increase of deaths from wasting chronic diseases and diarrhœal affections, of children under one year of age and persons upward of seventy years of age, shows the terrible effects of the prevailing intense heat of summer upon all who are debilitated by disease or age and thereby have their "heat-regulating power" diminished. The fact has been established by repeated experiment that when solar or artificial heat is continually applied to the animal the temperature of its body will gradually rise until all of the compensating or heat-regulating agencies fail to preserve the equilibrium, and the temperature reaches a point at which death takes place from actual combustion. In general, a temperature of 107° F. in man would be regarded as indicating an unfavorable termination of any disease. In persons suffering from sunstroke the temperature often ranges from 106° F. to 110° F., the higher temperature appearing just before a fatal termination.

The *indirect* effects of heat appear in the production of poisonous gases which vitiate the air and render it more or less prejudicial to health. Decomposition of all forms of refuse animal and vegetable matter proceeds with far greater rapidity during the summer quarter than during other months of the year. Among the early results of summer heat is the damage to food. Milk retailed through the city, the sole or chief diet of thousands of hand-fed infants, undergoes such changes as to render it not only less nutritious but also hurtful to the digestive organs. The vegetables and fruits in the markets rapidly deteriorate and become unfit for food. Meats and fish quickly take on putrefactive changes which render them more or less indigestible. The effect of this increase of temperature upon the refuse and filth of the streets, courts, and alleys, upon the air in close places, in the tenement houses, and upon the tenants themselves is soon perceptible. The foul gases of decomposition fill the atmosphere of the city and render the air of close and unventilated places stifling; while languor, depression, and debility fall upon the population like a widespread epidemic. The physician now recognizes the fact that a new element has entered into the medical constitution of the season. The sickly young, the enfeebled old, those exhausted from wasting diseases, whose native energies were just sufficient to maintain their tenure of life, are the first to succumb to this pressure upon their vital resources. Diarrhœal diseases of every form next appear and assume a fatal intensity, and finally the occurrence of sunstroke (or heat-stroke) determines the maximum effects of heat upon the public health. The sickness records of dispensaries and the mortality records of the Health Department show that a new and most destructive force is now operating, not only in the diseases above mentioned, but in nearly all of the diseases of the period. Fevers, inflammatory diseases, and others of a similar nature run a more rapid course, and are far less amenable to treatment. This is due, in the opinion of eminent medical authority, to the addition of the heat of the air to the heat of the body. Indeed, the only safety is in flight from the city to the country and to cool localities, as the seashore or the mountains. The immediate improvement of those suffering from affections of the city when transferred to the country is often marvelous, and shows conclusively how fatal is the element of heat in its direct and indirect effects upon the residents of the city.

Let us next consider the causes of high temperature in the city of New York. It is a well-established fact that the temperature of large and densely populated towns is far higher than the surrounding country. This is due to a variety of causes, the chief of which are the absence of vegetation; the drainage and hence the dryness of the soil; the covering of the earth with stone, bricks, and mortar; the aggregation of population to surface area; the massing together of buildings; and the artificial heat of workshops and manufactories.

The difference between the mean temperature of the city at Cooper Institute and at the Arsenal, Central Park, for a single month, illustrates this fact. Another striking difference between the temperature of these two points of observation is that the range is much greater at Central Park than at Cooper Institute, the temperature falling at night more at the former than at the latter place. The effect of vegetation is to lower the temperature at night, while brick and stone retain the heat and prevent any considerable fall of temperature during the twenty-four hours. It may be said of New York that it has all the conditions of increased temperature above given in an intensified form. It has a southern exposure; all of its broad avenues run north and south; the surface is covered with stone, brick, and asphalt; it is destitute of vegetation except in its parks, which have a very limited area compared with the needs of the city; its buildings are irregularly arranged and crowded together so as to give the largest amount of elevation with the least superficial area; ventilation of courts, areas, and living rooms is sacrificed; its ill-constructed and overcrowded tenement houses, especially of certain districts, have the largest population to surface area of any city in the civilized world. To these natural and structural unfavorable sanitary conditions must be added the enormous production of artificial heat in dwellings. When the summer temperature begins to rise the solar heat is constantly added to the artificial heat already existing. The temperature of the whole vast mass of stones, bricks, mortar, and asphalt gradually increases, with no other mitigation or modification than that caused by the inconstant winds and occasional rainstorms. And the evils of high temperature are yearly increasing as the area of brick, stone, and asphalt extends. The records of sunstroke during the past few years is appalling, both on account of the number of cases and their comparative increase. If no adequate remedy is discovered and applied, the day would not seem to be distant when the resident, especially if he is a laborer, will remain in the city and pursue his work during the summer at the constant risk of his life.

Turning now to consider the question of the measures which are best adapted to protect the present and future population of New York from the effects of high summer temperatures, we are met by many suggestions of more or less value. The more important methods proposed are: a large supply of public baths; the daily flushing of the streets with an immense volume of river water; recreation piers; excursions to the seashore; temporary residence in the country, etc. But these are for the most part temporary expedients, applicable to individuals, and are but accessory to some more radical measure which aims to so change the atmospheric conditions that excessive heat can not occur. The real problem to be solved may be thus stated: How can the temperature of the city of New York be so modified during the summer months as to prevent that extreme degree of heat on which the enormous sickness and death rate of the people depend? Discussing the subject broadly from this standpoint, it becomes at once evident that we must employ those agencies which in the wide field of Nature are designed to mitigate heat and purify the air and thus create permanent climatic conditions favorable for the habitation of man.

It requires but little knowledge of the physical forces which modify the climate of large areas of the earth's surface to recognize the fact that vegetation plays a most important part. And of the different forms of vegetation, trees, as compared with shrubs, plants, vines, and grasses, are undoubtedly the most efficient. This is due to the vast area of surface which their leaves present to the air on a very limited ground space. The sanitary value of trees has hitherto been practically unrecognized by man. With the most ruthless hand he has everywhere and at all times sacrificed this most important factor in the conservation of a healthful and temperate climate. He has found, too late, however, that by this waste of the forests he has by no means improved his own condition. The winters have become colder, the summers hotter; the living springs have ceased to flow perpetually; the fertilizing streams have disappeared; the earth is deeply frozen in winter and parched in summer; and, finally, new and grave diseases have appeared where formerly they were unknown.

It is well understood that the temperature in a forest, a grove, or even a clump of trees, is cooler in summer and warmer in winter than the surrounding country. Man and animals alike seek the shade of groves and trees during the heat of the day, and are greatly refreshed and revived by the cool atmosphere. The difference between the temperature of the air under and among the branches of a single tree, densely leaved, and the surrounding air, on a hot day, is instantly realized by the laborer or traveler who seeks the shade. The thermometer in the sun and shade shows a difference of twenty, thirty, and forty degrees, and in the soil a difference of ten to eleven degrees. The reverse is true in winter. The laborer and traveler exposed to the cold of the open country find in the forest a degree of warmth quite as great as in a building but imperfectly inclosed. Railroad engineers inform us that they have occasion to use far less fuel in passing through forests in winter than in traversing the same distance in the open country. When the ground in the fields is frozen two or three feet deep, its temperature in the forest is found above the freezing point.

Forests and even single trees have, therefore, a marked influence upon the surrounding atmosphere, especially during the summer, and they evidently tend to equalize temperature, preventing extremes both in summer and winter. Hence they become of immense value as sanitary agencies in preserving equality of climatic conditions.

It is believed by some vegetable physiologists that trees exert this power through their own inherent warmth, which always remains at a fixed standard both in summer and winter. "Observation shows," says Meguscher,* "that the wood of a living tree maintains a temperature of from 54° to 56° F., when the temperature stands from 37° to 47° F. above zero, and that the internal warmth does not rise and fall in proportion to that of the atmosphere. So long as the latter is below 67° F., that of the tree is always highest; but, if the temperature of the air rises to 67° F., that of the vegetable growth is the lowest." Since, then, trees maintain at all seasons a constant mean temperature of 54° F., it is easy to see why the air in contact with the forest must be warmer in winter and cooler in summer than in situations where it is deprived of that influence.†

Again, the shade of trees protects the earth from the direct rays of the sun, and prevents solar irradiation from the earth. This effect is of immense importance in cities where the paved streets become excessively heated, and radiation creates one of the most dangerous sources of heat. Whoever has walked in the streets of New York, on a hot summer's day, protected from the direct rays of a midday sun by his umbrella, has found the reflected heat of the pavement intolerable. If for a moment he passed into the dense shade of a tree, he at once experienced a marked sense of relief. This relief is not due so much to the shade as to the cooling effect of the vaporization from the leaves of the tree.

Trees also have a cutaneous transpiration by their leaves. And although they absorb largely the vapor of the surrounding air, and also the water of the soil, they nevertheless exhale constantly large volumes into the air. This vaporization of liquids is a frigorific or cooling process, and when most rapid the frigorific effect reaches its maximum. The amount of fluid exhaled by vegetation has been, at various times, estimated with more or less accuracy. Hales ‡ states that a sunflower, with a surface of 5.616 square inches, throws off at the rate of twenty to twenty-four ounces avoirdupois every twelve hours; a vine, with twelve square feet of foliage, exhales at the rate of five or six ounces daily. Bishop Watson, in his experiments

* Man and Nature. G. P. Marsh, New York, 1872.

† It is interesting to notice, in this connection, the remark of Angus Smith, that a temperature of 54° F. is important in the decomposition of animal and vegetable matter.

‡ Public Parks. By John H. Rauch, M. D., Chicago, 1869.

on grasses, estimated that an acre of grass emits into the atmosphere 6.400 quarts of water in twenty-four hours.

It is evident, therefore, that vegetation tends powerfully to cool the atmosphere during a summer day, and this effect increases in proportion to the increase of the temperature. The influence of trees heavily leaved, in a district where there is no other vegetation, in moderating and equalizing the temperature, can not be overestimated. The amount of superficial surface exposed by the foliage of a single tree is immense. For example, "the Washington elm, of Cambridge, Mass., a tree of moderate size, was estimated several years since to produce a crop of seven million leaves, exposing a surface of two hundred thousand square feet, or about five acres of foliage."

Trees regulate the humidity of the air by the process of absorption and transpiration. They absorb the moisture contained in the air, and again return to the air, in the form of vapor, the water which they have absorbed from the earth and the air. The flow of sap in trees for the most part ceases at night, the stimulus of light and heat being necessary to the function of absorption and evaporation. During the heated portions of the day, therefore, when there is the most need of agencies to equalize both temperature and humidity, trees perform their peculiar functions most actively. Moisture is rapidly absorbed from the air by the leaves, and from the earth by the roots, and is again all returned to the air and earth by transpiration or exudation. The effect of this process upon temperature and humidity is thus stated by Marsh: "The evaporation of the juices of the plant by whatever process effected, takes up atmospheric heat and produces refrigeration. This effect is not less real, though much less sensible in the forest than in meadow and pasture land, and it can not be doubted that the local temperature is considerably affected by it. But the evaporation that cools the air diffuses through it, at the same time, a medium which powerfully resists the escape of heat from the earth by radiation. Visible vapor or clouds, it is well known, prevent frosts by obstructing radiation, or rather by reflecting back again the heat radiated by the earth, just as any mechanical screen would do. On the other hand, clouds intercept the rays of the sun also, and hinder its heat from reaching the earth." Again, he says, upon the whole, their general effect "seems to be to mitigate extremes of atmospheric heat and cold, moisture and drought. They serve as equalizers of temperature and humidity."

Again, let us notice the effects of trees upon malarial emanations. The power of trees, when in leaf, to render harmless the poisonous emanations from the earth has long been an established fact. Man may live in close proximity to marshes from which arise the most dangerous malaria with the utmost impunity, provided a grove intervene between his home and the marsh. This function of trees was known to the Romans, who enacted laws requiring the planting of trees in places made uninhabitable by the diffusion of malaria, and placed groves serving such purposes under the protection of some divinity to insure their protection. It is a rule of the British army in India to select an encampment having a grove between the camp and any low, wet soil.

Finally, trees purify the atmosphere. The process of vegetable nutrition consists in the appropriation by the plant or tree of carbon. This element it receives from the air in the form principally of carbonic acid, and in the process of digestion the oxygen is liberated and again restored to the air, while the carbon becomes fixed as an element of the woody fiber. Man and animals, on the contrary, require oxygen for their nutrition, and the supply is in the air they breathe. Carbon is a waste product of the animal system, and, uniting with the oxygen, is expired as carbonic acid, a powerful animal poison. A slight increase of the normal quantity of carbonic acid in the air renders it poisonous to man, and continued respiration of such air, or a considerable increase of the carbonic acid, will prove fatal. The animal and vegetable world, therefore, complement each other, and the one furnishes the conditions and forces by which the other maintains life and health. "Plants," says Schacht, "imbibe from the air carbonic acid and other gaseous or volatile products exhaled by animals, developed by the natural phenomena of decomposition. On the other hand, the vegetable pours into the atmosphere oxygen, which is taken up by animals and appropriated by them. The tree, by means of its leaves and its young herbaceous twigs, presents a considerable surface for absorption and evaporation; it abstracts the carbon of carbonic acid, and solidifies it in wood fecula, and a multitude of other compounds. The result is that a forest withdraws from the air, by its great absorbent surface, much more gas than meadows or cultivated fields, and exhales proportionally a considerably greater quantity of oxygen. The influence of the forests on the chemical composition of the atmosphere is, in a word, of the highest importance." *

In large cities, where animal and vegetable decomposition goes on rapidly during the summer, the atmosphere is, as already stated, at times saturated with deleterious gases. At the period of the day when malaria and mephitic gases are emitted in the greatest quantity and activity, this function of absorption by vegetation is most active and powerful. Carbonic acid, ammoniacal compounds, and other

* Les Arbres, quoted by Marsh.

gases, products of putrefaction, so actively poisonous to man, are absorbed, and in the process of vegetable digestion the deleterious portion is separated and appropriated by the plant, while oxygen, the element essential to animal life, is returned to the air. Trees, therefore, in cities, are of immense value, owing to their power to destroy or neutralize malaria, and to absorb the poisonous elements of gaseous compounds, while they render the air more respirable by emitting oxygen.

The conclusion from the foregoing facts is inevitable that one of the great and pressing sanitary wants of New York city is an ample supply of trees. It is, in effect, destitute of trees; for the unsightly shrubs which are planted by citizens are, in no proper sense, adequate to the purpose which we contemplate. Its long avenues, running north and south, without a shade tree, and exposed to the full effect of the sun, are all but impassable at noonday in the summer months. The pedestrian who ventures out at such an hour finds no protection from an umbrella, on account of the radiation of the intense heat from the paved surface. Animals and man alike suffer from exposure in the glowing heat. Nothing mitigates its intensity but the winds or an occasional rainstorm. And when evening comes on, the cooling of the atmosphere produced by vegetation does not occur, and unless partially relieved by favoring winds or a shower the heat continues, but little abated, and the atmosphere remains charged with noxious and irrespirable gases. It is evident that shade trees, of proper kinds, and suitably arranged, supply the conditions necessary to counteract the evils of excessive heat. They protect the paved streets and the buildings largely from the direct rays of the sun; they cool the lower stratum of air by evaporation from their immense surfaces of leaves; they absorb at once the malarious emanations and gases of decomposition, and abstract their poisonous properties for their own consumption; they withdraw from the air the carbonic acid thrown off from the animal system as a poison, and decomposing it, appropriate the element dangerous to man, and give back to the atmosphere the element essential to his health and even life.*

And we may add that cultivated shade trees in New York would be an artistic and attractive feature of the streets. Every citizen enjoys trees, as is evident from the efforts made to cultivate them throughout the city.

It is frequently alleged that trees can not be successfully cultivated in cities on account of the gases in the soil. There are ample proofs to the contrary. The city of Paris strikingly illustrates the

* The late Dr. Francis remarked that he had noticed a marked increase in the fatality of diseases in sections of the city after the removal of trees and all vegetation.

possibility of cultivating a large variety of trees in the streets and public places of large cities when the planting and cultivation is placed under competent authority. In our own country the cities of New Haven and Washington are examples of the successful cultivation of trees to an extent sufficient to greatly modify the summer temperature. Authorities on landscape gardening and forestry sustain the view that under proper supervision by competent and skilled persons a great variety of trees, shrubs, plants, and vines can be cultivated in the streets and public places of this city. Mr. Frederick Law Olmstead, to whom the city is so much indebted for his intelligent supervision of Central Park in its early period, warmly supported a movement to cultivate trees, shrubs, plants, and vines in the streets of New York. Dr. J. T. Rothrock, the very able and experienced Commissioner of Forestry of Pennsylvania, under date of October 10, 1898, speaking of the proposed plan of securing the cultivating trees in the streets of this city, remarks: "I think it an excellent measure, and I am sure that during the torrid season the more tree shade you have the fewer will be your cases of heat exhaustion. It is idle to say, as is often said in this country, that trees can not be made to grow in our cities. Under existing conditions the wonder is, not that trees look unhealthy in most cities, but that any of them manage to live at all. It is perfectly well known that the city of Paris has thousands of trees growing vigorously under such surroundings as the American gardener would think impossible. Two things are necessary to success—viz., first, the kinds of trees to endure city life must be found; and, second, select from among them such as are adapted by their size and shape to each special place."

Mr. Gifford Pinchot, of the Division of Forestry, Department of Agriculture, Washington, writes under date of December 2, 1898: "Street trees are successfully planted in great numbers in all of the most beautiful cities of the world. Washington and Paris are conspicuous examples. That such trees succeed is largely due to the great care taken in setting them out. The attractiveness of cities has come to be reckoned among their business advantages, and nothing adds to it more than well-selected, well-planted, and well-cared-for trees. On the score of public health trees in the streets of cities are equally desirable. They become objectionable only when badly selected and badly maintained."

In a recent paper on Tree Planting in the Streets of Washington, Mr. W. P. Richards, surveyor of the District of Columbia, remarks that, under the plan adopted, "tree planting has never been at an experimental stage" in that city. "Washington was a city of young trees during the seventies, and in the spring of 1875 more than six thousand trees were planted, consisting of silver maples, Norway maples, American elms, American and European lindens, sugar maples, tulip trees, American white ash, scarlet maples, various poplars, and ash-leaved maples. . . . A careful count was made of the trees in 1887, and by comparing this with the number of trees since planted and those removed, there is found to be more than seventy-eight thousand trees, which if placed thirty feet apart would line both sides of a boulevard between Washington and New York. These consist of more than thirty varieties." Mr. Richards adds: "The planting and care of trees in Washington grows from year to year, and the future will probably demand more skill and judgment than in years past. About twenty thousand dollars is spent annually, most of it in the care of old trees. From one to three thousand young trees are planted during the spring and fall of each year. The nursery has several thousand of the best varieties ready for planting."

The opinions of these authorities and the success of the work in Washington, now extending over a quarter of a century, determine beyond all question the feasibility and practicability of successfully cultivating trees in the streets of cities. And if any one doubts the power of trees cultivated in the streets to change the temperature of a city let him calculate the amount of foliage which the seventy-eight thousand trees, when full-grown, will furnish the city of Washington, taking as his basis the fact that a single tree, the Washington elm, at Cambridge, Massachusetts, when in full leafage, equals five acres of foliage, and that one acre of grass emits into the atmosphere 6.400 quarts of water in twenty-four hours, a powerfully cooling process.

We have, finally, to consider through what agency the proposed cultivation of trees in the city of New York can be accomplished most rapidly and successfully. Three methods may be suggested, viz.: 1. Encourage citizens each to plant and cultivate trees on his own premises. 2. Organize voluntary "tree-planting associations," which shall aid citizens or undertake to do the work at a minimum cost. 3. Place the work under the entire supervision and jurisdiction of public authority. The first method has been on trial from the foundation of the city, and its results are a few stunted apologies for trees which are useless for sanitary purposes and unsightly for ornamentation. The average citizen is entirely incompetent either to select the proper tree or to cultivate it when planted. Tree-planting associations have proved useful agencies in exciting a popular interest in the subject, and in aiding citizens in the selection of suitable trees and in cultivating them. The Tree-Planting and Fountain Society of Brooklyn, under the very able management of its accomplished secretary, Prof. Lewis Collins, is a model organization of the kind, and has accomplished a vast amount of good in this field in that city. But it may well be questioned if we have not reached a period of sanitary reform in cities when a work of the kind we contemplate in New York should not be undertaken by the strong arm of the city government, as a matter of public policy, and carried steadily forward to its completion. The growth of the greater city is far too rapid in every direction to await the slow movements of the people under the pressure of voluntary organizations. The best work can be done in those outlying districts where the streets are as yet but sparsely built upon, and the soil has been undisturbed. Again, it is of the utmost importance that a work of this kind, which will largely prove one of city ornamentation, should be under the exclusive direction of a skilled central authority having ample power and means to harmonize every feature of the work from the center of the city to its remotest limits. Finally, the successful cultivation of trees and other vegetation in our streets can be successfully carried on only by experts in the art of tree culture, who devote their entire time and energies to these duties, and are sustained by the power of the city government. Mr. Frederick Law Olmstead remarks, "Not one in a hundred of all that may have been planted in the streets of our American cities in the last fifty years has had such treatment that its species would come to be if properly planted and cared for." Mr. Richards, in the paper referred to on Tree Planting in the Streets of Washington, makes the following statement: "The selection, planting, and care of all trees in the streets of Washington are under the direction of the District authorities; individual preferences and private enterprises are not allowed to regulate this improvement, as is generally done in other cities. Moreover, the city has its own nursery, where seeds planted from its own trees grow and supply all the needed varieties."

It is apparent that to accomplish such a work as we propose the undertaking must be placed under the jurisdiction of a department of the city government, skilled in the performance of such duties, fully equipped with all needful appliances, and clothed with ample power and supplied with the financial resources necessary to overcome every obstacle. Fortunately, we have in our Department of Parks an organized branch of the city administration endowed with every qualification for the performance of these duties. The charter provides as follows: "It shall be the duty of each commissioner . . . to maintain the beauty and utility of all such parks, squares, and public places as are situated within his jurisdiction, and to institute and execute all measures for the improvement thereof for ornamental purposes and for the beneficial uses of the people of the city, . . . and he shall have power to plant trees and to construct, erect, and establish seats, drinking fountains, statues, and works of art, when he may deem it tasteful or appropriate so to do." At the head of this service is "a landscape architect, skilled and expert, whose assent shall be requisite to all plans and works or changes thereof respecting the conformation, development, or ornamentation of any of the parks, squares, or public places of the city, to the end that the same may be uniform and symmetrical at all times."

The conclusion seems inevitable that public policy requires that, in the interests of the health of the people and the comfort and well-being of that large class of the poor who can not escape the summer heat by leaving the city, the jurisdiction of the Park Department should be extended to all trees, shrubs, plants, and vines now and hereafter planted and growing in the streets of New York, and that said department should be required to plant such additional trees, shrubs, etc., as it may from time to time deem necessary and expedient for the purpose of carrying out the intent and purpose of such act which should be declared to be to improve the public health, to render the city comfortable to its summer residents, and for ornamentation.

"He who plants a tree, he plants love;
Tents of coolness, spreading out above
Wayfarers, he may not live to see.
Gifts that grow are best,
Hands that bless are blest.
Plant. Life does the rest."

MIVART'S GROUNDWORK OF SCIENCE.*

By Prof. WILLIAM KEITH BROOKS.

IF books like this by Professor Mivart, who holds that "the groundwork of science must be sought in the human mind," help to teach that the greatest service of science to mankind is not "practical," but intellectual, they are worthy the consideration of the thoughtful, even if this consideration should lead some of the thoughtful to distrust Mivart's groundwork, or to doubt whether it is firm enough for any superstructure.

Many, no doubt, think the desire to know a sufficient groundwork for science, believing that they wish to know in order that they may rightly order their lives; but the school to which Mivart belongs

* The Groundwork of Science. A Study of Epistemology. By St. George Mivart, M. D., Ph. D., F. R. S. New York: G. P. Putnam's Sons, 1898.

tells them all this is mere vulgar ignorance, since the groundwork of science is, and must be, something known, rather than a humble wish to know.

According to Mivart, the groundwork of science consists of truths which can not be obtained by reasoning, and can not depend for their certainty on any experiments or observations alone, since whatever truths depend upon reasoning can not be ultimate, but must be posterior to, and depend upon, the principles, observations, or experiments which show that it is indeed true, and upon which its acceptance thus depends. The groundwork of science must therefore be composed, he says, of truths which are self-evident; and he assures us that, if this were not the case, natural knowledge would be mere "mental paralysis and self-stultification."

He would tell the wayfarer who, having been lost among the mountains, comes at last upon a broad highway winding around the foothills and stretching down over the plain to the horizon, that an attempt to go anywhere upon this road is "mere paralysis," unless he knows where it begins and where it ends. He would have told the ancient dwellers upon the shores of the Nile that their belief that they owed to the river their agriculture, their commerce, their art and science, and all their civilization, was mere self-stultification, because they knew nothing of its sources in the central table-land.

May not one believe, with Mivart, that the scientific knowledge which arises in the mind by means of the senses through contact with the world of Nature, thus arises by virtue of our innate reason, and yet find good ground for asking whether physical science may not have something useful and important to tell us about the mechanism and history of this innate reason itself? Is proof that our reason is innate, or born with us, proof that it is ultimate or necessary or beyond the reach of improvement and development by the application of natural knowledge? May not this reason itself prove, perhaps, to be a mechanical *phenomenon* of matter and motion, and a part of the discoverable order of physical causation; and may not science some time tell us how it became innate, and what it is worth?

Questions of this sort are easy to ask but hard to answer; for many hold our only way to reach an answer to be *to find out* by scientific research and discovery. While this method may be too slow for *a priori* philosophers, may it not be wise for those who, being no philosophers, know of no short cut to natural knowledge, to admit that, while they would like to know more, they have not yet learned all there is to learn? If this suspension of judgment is indeed self-stultification, the case of many students is hard, though they may not really find themselves so helpless as they are told that they must be; for he who is told by the learned faculty that he is paralyzed need not be greatly troubled if he finds his powers for work as much at his command as they were before.

The modern student has heard so many versions of the story of the two-faced shield that he is much disposed to suspect that many of the questions which have so long divided "philosophers" may be only new illustrations of the old fable, and he asks whether there need be any real antagonism between those who attribute knowledge to experience and those who attribute it to our innate reason.

There are men of science who, seeing no good reason to challenge Plato's belief that experience, creating nothing, only calls forth the "ideas" which were already dormant or latent in the mind, do nevertheless find reason to ask whether exhaustive knowledge of our physical history may not some time show how these dormant "ideas" came to be what they are. They ask whether errors may not be judgments which lead us into danger and tend to our physical destruction, and whether it may not be because a judgment has, in the long run, proved preservative in the struggle for existence that we call it true. May not, for example, the difference between the error that the stick half in water is bent and the truth that the stick in air is straight, some time prove to be that the savage who has rectified his judgment has speared his fish, while he who has not has lost his dinner?

So long as we can ask such questions as this, how can we be sure that because a judgment is no more than might have been expected from us, as Nature has made us, at our present intellectual level, it is either necessary or ultimate or universal? Things that are innate or natural are not always necessary or universal, for while reason is natural to the mind of man, some men are unreasonable, and a few have been even known to be illogical.

It therefore seems clear that another view of the groundwork of science than that set forth by Professor Mivart is possible, for many believe that this groundwork is to be found in our desire to know what we do not yet know, rather than in things known; and they believe they wish to know in order that they may learn to distinguish truth from error, and walk with sure feet where the ignorant grope and stumble.

Many books are profitable and instructive even if they fail to convince; and the question which a prospective student of Mivart's book is likely to ask is whether it is consistent with itself; for if the author has not so far made himself master of his subject as to state his case without palpable contradiction, no one will expect much help from him. It is a remark of Aristotle, in the Introduction to the Parts of Animals, that while one may need special training to tell whether an author has proved his point, all may judge whether he is consistent with himself, and the attempt to learn whether Mivart's book is consistent may not greatly tax our minds.

He tells us that many men of science are "idealists"; and he says that idealism, being mere self-stultifying skepticism, must be refuted and demolished before we can begin our search for the groundwork of science or be sure that we know anything. It would have surprised Berkeley not a little to be told that his notions are the very essence of skepticism, for the good bishop tells us again and again that his only motive in writing is to make an end of idle skepticism, once for all, that they who are no philosophers, but simple, honest folks, may come by their own and live at ease.

There is little ease, and less justice, even at this late day, for the man of science who insists that he is neither an idealist nor a materialist nor a monist, but a naturalist; and that it will be time enough to have an opinion as to the relation between mind and matter when we find out; but many will, no doubt, be pleased to hear that the crime of which they are now suspected is no longer "materialism," but "idealism," for the public attaches no odium to the idealist, whatever may be Professor Mivart's verdict. Still all must feel an interest in the exposure of the weakness of idealism, since we have been told, by many shrewd thinkers, that Berkeley's statement of the case, while inconclusive, is unanswerable; although they hold that it is lack of experimental evidence which stands in the way of either its acceptance or its refutation.

Mivart begins his treatment of idealism by a simple and satisfactory summary, pages 36–38, of Berkeley's Principles, but he forgets it on the next page, for it is no exaggeration to assert that the "idealism" which he refutes is a mere parody on that which he has just given his readers, and something that no sane man would dream of holding.

For example, he admits, on page 38, that nothing "can be more absurd than the criticism of those persons who say that idealists, to be consistent, ought to run up against lamp-posts, fall into ditches, and commit other like absurdities." On page 47 he undertakes to show, "by the natural spontaneous judgment of mankind," that external material bodies exist "of themselves, and have a substantial reality in addition to that of the qualities we perceive; because the spontaneous judgment of mankind accords with what even animals learn through their senses. A wide river is an objective obstacle to the progress of a man's dog, as well as to that of the dog's owner."

One who compares the extract from page 38 with this from page 47 can, so far as I can see, reconcile them only by one of these hypotheses: 1, that Mivart holds a wide river to afford proof of reality which is not afforded by a ditch; or, 2, that the dog which does not run against lamp-posts affords evidence of the reality of Nature which is not afforded by a man in the same circumstances; or, 3, that "nothing can be more absurd than the criticism of these persons" who reason like Professor Mivart.

While sometimes right and sometimes wrong, like the rest of us, the apostle of tar water was no fool, although the groundwork of Mivart's science, in the book before us, is the assertion that idealists idiotically deny everything which they have not perceived, and hold that the external world has no existence.

It is hard to see how words could be clearer than those in which Berkeley repudiates all nonsense of this sort. "I do not argue," says he, "against the existence of any one thing that we apprehend, *either by sense or by reflection*. That the things I see with my eyes and touch with my hands do exist, really exist, I make not the least question. I am of a vulgar cast, simple enough to believe my own senses, and to take things as I find them. To be plain, it is my opinion that the real things are the very things that I see and feel, and perceive by my senses. I can not for my life help thinking that snow is white and fire hot. And as I am no skeptic with regard to the nature of things, so neither am I as to their existence. That a thing should be really perceived by my senses, and at the same time not really exist, is to me a plain contradiction. Wood, stone, fire, water, flesh, iron, and the like things, which I name and discourse of, are things I know. Away, then, with all that skepticism, all those ridiculous philosophical doubts! I might as well doubt of my own being as of the being of those things I actually see and feel."

Mivart lays great stress upon the opinion of men in general as a refutation of idealism; and as Berkeley also says he is content to appeal to the common sense of the world, it may be well to ask what the verdict of "plain, untutored men" is, even if we doubt whether such a jury is the highest tribunal.

"Ask the gardener," says Berkeley, "why he thinks yonder cherry tree exists in the garden, and he shall tell you, because he sees it and feels it."

Mivart holds it one thing to see, and quite another matter to know that we see, for he says that while we see and feel the "qualities" of things by those "lower faculties" which we share with the "brutes," we perceive the "substance" in which these qualities inhere, by certain "higher faculties," which, whether represented in the brutes by latent potencies or not, have been "given" to man in their completeness, and not slowly and gradually built up from low and simple beginnings in the brutes.

The question we are to ask the gardener is, therefore, something to this effect: Whether he thinks the cherry tree exists because he sees it and feels it, or because, when he sees it and feels it, he knows that he does so?

If he weighs his words will he not ask how he can know that he does see it and feel it unless he knows that he does so? I, myself, am no philosopher; but, to my untutored mind, Mivart's distinction between things perceived by *sense*, and things *perceived* by sense, seems a mere verbal difference of accent and emphasis, rather than a fundamental distinction.

As most men use the word, "mind" implies consciousness of that sort which Mivart calls self-consciousness, and while there is no reason why those who choose should not so use the word as to include unconscious or "subconscious" or "consentious" cerebration, most plain, untutored men prefer to use words as their neighbors do.

If long waiting on Nature has given to the old gardener more shrewdness than we commonly find in those whose pursuits are less leisurely, he may say that, while he knows the tree is there because he has planted it and tended it and watched it grow, it now falls on his eyes day after day, without attracting his notice, unless something about it which calls for his skill *catches* his eye, and *commands* his *attention*.

If we see reason to believe that this difference is a matter of words and definitions, rather than a real difference in kind; if we fail to find any sharp dividing line between unperceived cerebration and "mind," is not this, in itself, enough to lead even Macaulay's schoolboy to ask whether mind may not be a slow and gradual growth from small beginnings, and a co-ordinated whole, to the common function of which all its parts contribute, rather than a "gift" of "lower faculties" and "higher faculties"?

We must ask, however, whether mechanical explanations of mind are in any way antagonistic to the conviction that it is a gift. May not one study the history of the mechanism of mind, and the way this mechanism works, in a spirit of profound and humble gratitude to the Giver of all good gifts?

Is the lamentable prevalence, among plain untutored men, of the notion that mechanical explanations of Nature are inconsistent with belief that all Nature is a gift, to be laid to the charge of the men of science?

Is it not rather the poisonous fruit of the ill-advised attempts of "philosophers" like Professor Mivart to teach that a gift can not be a gift at all unless it is an arbitrary interruption to the law and order of physical Nature?

THE SCIENCE OF OBSERVATION.

By CHARLES LIVY WHITTLE.

THIS is an era of observation; in many fields and in divers countries the study of Nature from a strictly scientific standpoint is being prosecuted with results which are rapidly increasing our knowledge of the universe. This modern growth has come about as the natural rebound of the suppressed energy that has been held forcibly under subjugation during the last two thousand years, at a time when the closing echoes of the warfare between the literal interpretation of the Scriptures and science have ceased.

A review of this long battle with the forces of the Catholic and Protestant churches on the one hand, arrayed against a relatively few investigators, scattered through the last ten centuries, on the other hand, shows a record on which none can look without regret. As far as we are able to learn, there was little opposition to the study of science before the collection and translation of the old manuscripts now constituting the Alexandrian version of the Bible and the consequent upbuilding of the Jewish church. The remains of ancient Egyptian civilization show that science prior to that period, as measured by the discoveries in physics and astronomy, had attained no inconsiderable prominence; and had this people endured until the present time, uninfluenced by the strife that for many centuries racked the inhabitants of the eastern hemisphere, we should to-day be far more advanced in our understanding of the universe.

In the more progressive countries, at least, the breaking of the shackles in which the investigating mind had been imprisoned for so long has led not only to a greater number of scientific workers, but also to an increase in the fields of observation. The methods of investigation have likewise undergone a transformation. In place of deductive reasoning, even as late as a few decades in the past, conclusions and generalizations are now founded on lines of thought more largely inductive. Men of middle age are able to recall the time when even our leading institutions of learning required instruction in several branches of science to be given by one teacher. It was possible twenty-five years ago for a man of great ability to master the essentials of the leading sciences and to teach them, but under the present stimulus for investigation no one can hope to excel in more than one subject. It has thus come about that in place of the many-sided teacher of science we now have in our larger universities specialists in every subject. As the work of research progresses, the specialist—for example, in geology—is compelled by the increased scope of the information on his subject to select one branch of geology of which he shall be master. The chair of geology is now split up into economic, glacial, and mining geology, paleontology, etc., and specialists are required in each division. This breaking up is true of most other sciences. In this labyrinth of specialized subjects, and the maze of technical terms rendered necessary thereby, the people as a whole can only grope in darkness; but out of this bewildering condition of affairs, from the mass of facts collected, and the resulting generalizations and theories, there may be culled the kernel of one important principle by means of which these facts are ascertained and the generalizations made. The growth of science and its ever-ramifying divisions, and the gradual establishment of new methods of investigation, have brought forth what may be termed the science of observation; and it is through an application of the above principle that the people may be taught correctly to interpret Nature, and, by their new habit of thought, to free the brain from the tangle of superstition which is still present with most of us.

A knowledge of how to observe natural phenomena and to draw correct inferences therefrom has been the product of slow growth, while through long custom, in matters closely pertaining to our daily life, there has been observation on strictly scientific principles for centuries. Stated succinctly, natural phenomena are due to causes, one or more, simple or complex. These causes are the laws of the universe, and to arrive at an understanding of them we must free our minds of any bias and study phenomena experimentally in the laboratory, or in our daily contact with Nature. In this way a mass of facts will be gathered by the systematic observer which will be found to fall into natural groups, and by inductive reasoning the laws governing each group may be learned. It is not possible for mankind as a whole to investigate in this exhaustive manner; but it is important that the method of arriving at the laws of Nature be understood. Many and, in fact, most phenomena met with in some of the sciences, particularly those having to deal with the earth, are susceptible of correct interpretation without attempting broad generalizations, if the principles of scientific observation are brought to bear upon their solution, and it is our purpose to show by practical examples drawn from Nature how elementary students may attack and solve some of the simple problems met with on every side. It is proposed to use for illustration simple phenomena pertaining to the earth, drawn from geology and its newly constituted sister science, physical geography. These two sciences perhaps afford the greatest range of phenomena, which are accessible to every one, in whatsoever part of the earth he may reside. No part of the land surface is wanting in problems which demand explanation, and which may be

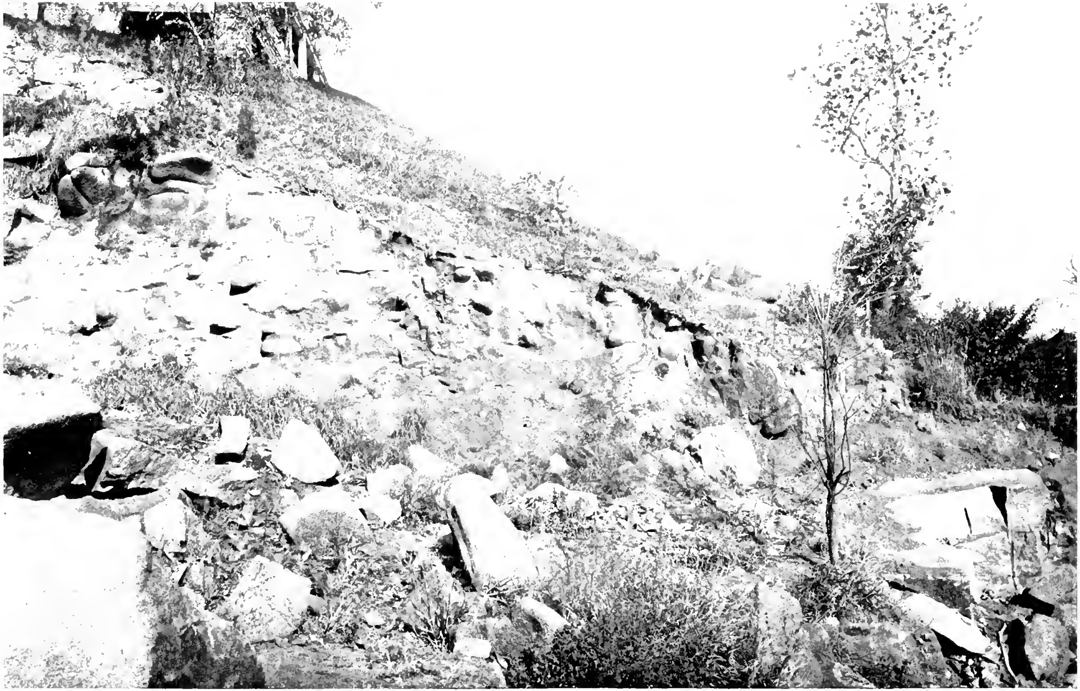

Fig. 1.—Quarry showing Fresh and Weathered Rocks.

attacked from the standpoint of the geologist or physical geographer, or both.

One of the most pronounced departures taking place in preparatory-school education at the present time is to be found in the prominence given to these subjects, not only in the schoolroom, but by practical experience in the laboratory of Nature, among the hills and mountains, as well. The object of this departure is twofold: the first and most imoprtant is to train the young early to observe phenomena and to interpret them; the second, in a narrower sense, is purely educational. The one inculcates a habit of thought that will be of inestimable advantage in pursuing future study; the other, without taking into consideration the element of mental training, constitutes instruction in concrete things that are matters of general education.

Before the student in the introductory schools is brought in contact with problems in the field, it is essential that he receive textbook or oral instruction in some of the geological processes giving rise to the phenomena to be studied later out of doors. In practical teaching the student is taken on excursions into the region not far removed from the school. At first some simple geological facts are shown him, often on a very small scale, but embodying principles which, when understood, lead to a ready interpretation of larger problems. Step by step the first principles are amplified by a larger and more varied class of examples, until the student is able logically to apply the reasoning in explanation of simple problems to the solution of the greater problems in physical geography and geology. In the absence of such excursions, I shall introduce a series of photographs carefully arranged to lead the reader along the same line of reasoning up to similar broad conclusions—a method which, if not so satisfactory and instructive, will at least have an educative value.

Our first excursion will be to a locality where an open cut has been made for the purpose of carrying on quarrying operations. The accompanying photograph has been so taken as to include both the top and the bottom of the quarry (Fig. 1). Let us first inspect the rock in the lower part of the quarry. The existence of planes of fracture, or joints, crossing the rock in various directions, dividing it into blocks, early attracts our attention. The stone appears dark-colored, tough, and is seen to be made up of two or three different minerals: one is black, cleaves readily into thin plates of a translucent nature, and we easily recognize it as an iron-bearing mica, or isinglass. Another is white, and cleaves or breaks in two directions, making angles of about ninety degrees; this we know as common feldspar. The third is less easily recognized as pyroxene, another of the many minerals containing iron. Having tested our knowledge of mineralogy, we will look about and see if all the rock exposed is like that at the bottom of the quarry. As we ascend from the point indicated by the lower hammer, we notice that the dark blue rock gradually takes on a rusty hue, and its toughness has become less. Going still higher, the rusty character increases, and along joints the rock is so lacking in coherency as to fall to pieces when struck a light blow with a hammer. The central portions of the blocks, however, after we have removed the outer shell of rusty

FIG. 2.—DETAILED VIEW OF A PORTION OF QUARRY SHOWING WEATHERED ROCK.

material, are seen to be like the lower rock. In the middle foreground of the picture there are shown several bowlders derived from above, which are merely these residual cores, and are known as bowlders of disintegration. These are also shown in place near the top of the picture at the extreme left. Near the top of the quarry, at a point marked by the upper hammer, the solid rock gives place to a rusty mass of loose material, traversing which the cracks may still be seen, and in which there are few indications of the solid rock * (see Fig. 2). This loose material when carefully examined is found to

* The position of the solid rock is shown by the hammer at the extreme right, standing vertically.

be made up of exactly the same minerals as the dense rock below, but we notice that the mica and pyroxene are rusty and that the feldspar is stained yellowish brown. The pyroxene in particular is very much changed, and quickly crumbles away in the hand. It is clear that there is every stage between the solid rock and the incoherent powder at the surface of the ground. The joint planes crossing the solid rock below may still be observed traversing the decayed portion, and also many rounded areas of rock, which are seen to be identical with the stone at the bottom of the quarry.*

How shall the facts before us be explained? It has been shown that the dense rock and the loose material are the same mineralogically, and grade from one into the other, and it is certainly rational to suppose that the latter is merely a changed form of the first. Some force must have been at work on the solid rock, destroying its coherency and converting it into loose sand. If we inspect the powdered rock, it will become apparent that this change has been brought about mainly by the process of weathering: surface water, with its ever-present acid impurities, has brought about the partial decay of the pyroxene and mica and caused the disintegration of the upper part of the rock. Water has not only attacked the rock from the upper surface, but has penetrated to considerable depths along the joint planes, working inward toward the center of each block until the mass becomes completely disintegrated. This process explains the concentric shells about cores of unaltered rock, each representing original joint blocks, which are seen in the second photograph. All our excursions into the field will show that this is not an isolated case, for wherever a ledge is exposed to our view there will be found a zone of weathered rock, varying in thickness from mere films to many feet.

By this process the greatest part of the materials constituting soils is formed, and the flora and fauna of the earth are rendered possible. Upon such products of decay the food supply of running water manifestly depends in a large measure, as will be pointed out on our next excursion; and were the scope of this article somewhat larger, it would be easy to show that the rock decay seen in our photograph has taken place in a length of time measured by something like ten thousand years. If all rock decayed as easily, and if the rate of decomposition, as determined here, held good for great distances from the surface, mountains two miles in height would become a prey to

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* This photograph represents a more detailed view of the quarry wall seen in Fig. 1. The relation of the two views will be understood by observing the positions of the hammers, which are in the same place in both photographs. These photographs, as well as some of the others that follow, were taken by Mr. John L. Gardner, 2d, for the purpose of illustrating these pages.

the force of chemical action in six and a half million years. We can not, however, give a time equivalent for the destruction of a mountain range, since decay, and consequent disintegration, is only one of the many forces acting to sap the strength of solid rocks and to tear them asunder. The above figures are given merely to make plain that the time necessary to accomplish the leveling of a mountain chain is but a small part of the earth's existence as such, great as this period may seem from the standpoint of human history.

We shall, if possible, time the second excursion immediately after a heavy rain, and we shall select for our objective point a place

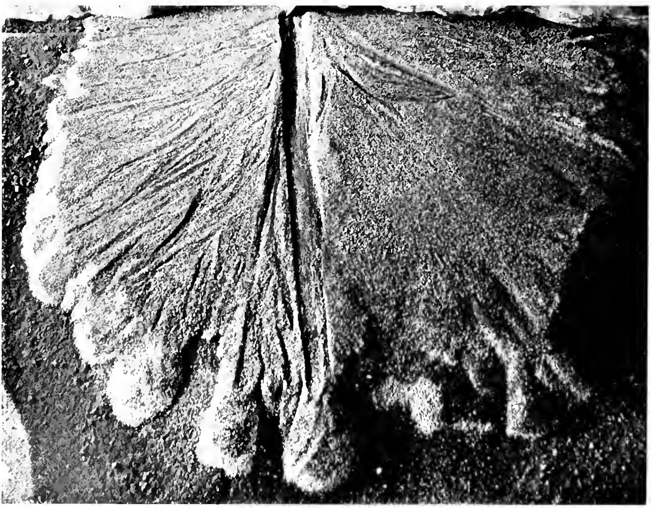


Fig. 3.—Temporary Wet-weather Delta.

where the rain water, in its efforts to reach a stream, is forced to run down some steep declivity. Under such circumstances, the carrying power of the water will be very great, and we shall hope to find evidence of its work in transporting the products of rock weathering and other material broken up by the action of frost. A little diligence will soon reward us with the evidence which we seek. A local inequality of the ground, perhaps only a few feet across, is found filled with water—a minute, temporary lake caused by the recent heavy rainfall. Such little water bodies are extremely common, but the accompanying geological phenomena are, notwithstanding, none the less interesting, and the conclusions to be drawn from the evidence thus presented are none the less valuable.

If we examine the pool critically, it will be noticed that its shore line is cut by a little channel along which the overflow makes its escape. Further investigation will show that at another point along the shore, especially if we are fortunate enough to visit the locality very soon after a rain, there is a small rivulet entering the pool; and also that the entering stream is discolored with mud and carries more or less sand, while the escaping stream is nearly clear, and is free from all traces of coarse, sandy material. It is therefore evident that the sediment brought in by the stream has been left behind in the pool, and of course will be found deposited at its bottom, and it will appear that the only explanation of the inability of the water further to transport its burden is to be found in the fact that water loses nearly all its motion, and therefore its transporting power, on entering a stagnant pool. These are elementary truths, but an amplification of such simple phenomena is often fully capable of accounting for the most stupendous results.

Having made these observations, let us look at the form assumed by the sediment when it is forced to fall to the bottom. At the point where the stream enters the pool there is seen an accumulation of material having a nearly level upper surface, presenting a scalloped or lobe-shaped outer margin, upon which the stream may be seen flowing and entering the water at one of the lobes. Other channels, though unoccupied by water, also lead to similar lobes. If we watch closely, we may be able to witness the growth of this body of sand, called a delta, as the falling sediment rapidly increases the size of the lobe; and also to perceive that as soon as the lobe is built out considerably in advance of the main body of sand, it will be easier for the stream to enter the water on one side of the scallop, thus abandoning its old mouth. In this manner the stream moves from one place to another, successively building the little scallops and continually carving new channels for itself. Fig. 3 is a photograph of such a delta, some three feet across, taken after the water had been drained away, and reveals its form in a characteristic manner. As we watch its growth, it will become evident that only the coarsest material transported by the stream goes to make up the delta, and that the clay and finest sand are deposited farther awy, where the water is more quiet, or else pass out in the stream draining the pool. Let us look about a little. Not far from our miniature lake there are several others. In some the size of the delta is much larger in proportion to the area of the pool than is the case with the one first studied. We find in some cases that the stream has progressively built its delta completely across the old water surface. Taking a thin piece of board or a large knife, we can easily cut vertically through this sand deposit, thus exposing what is called a geological section.

The sand grains of which the deposit is largely composed are seen to be arranged in layers nearly horizontal, and these layers are found to be due to alternations of sediment varying in fineness. This phenomenon is called stratification, and is what we should expect of the action of gravity operating on material of different sizes and densities suspended in a body of water. It has been found inexpedient to attempt to show a photograph of this section, owing to the smallness of the subject, but the same phenomena may be observed on a much larger scale in Fig. 5, which will be described below.

A few rods away the stream that feeds the pool has its origin. The sediment carried by the water and going to build up its delta has its source in part in a neighboring bank made up of material derived from solid rock by weathering, similar to that shown on our first excursion, and partly from older water deposits. Steep channels exist in the disintegrated rock, which represent the material removed by the fast-flowing rain water.

Now what geological phenomena have we observed at this locality? In the first place, it has become clear that running water possesses the power of transporting sediment. In the second place, this sediment has been deposited wherever the velocity of the water has been materially checked. The sediment has been laid down in horizontal layers under the influence of gravity. Furthermore, the material of which the delta is composed has been shown, in part at least, to have been derived from a solid rock such as forms our mountains. In our first excursion we saw that chemical change promoted disintegration; in our second, running water is observed seizing upon these products of decay, transporting them and building them into stratified deposits in the first convenient pool. A level-topped delta is first formed, which may or may not grow to fill the pool in which it is born. Some of the pools have become filled, while the delta as such has disappeared; it has grown into a tiny sand plain.

Let us see if the work performed by these temporary rivulets is typical of running water in general. For this purpose we shall visit a spot where a river enters some considerable body of water such as a lake. Let us inspect the river. Its water is sluggish, discolored by organic matter derived from decaying vegetation, and for some distance up stream from its mouth it meanders slowly across a flat, marshy area or meadow. If we also visit the spot at a time when the river is swollen by heavy rains or melting snows, the presence of this organic matter will be masked by the turbidity of the water; we shall learn that only in the freshet seasons does the water attain sufficient velocity to carry any visible load of sand and clay. The upper end of the lake will be found to be shallow, muddy, and water lilies will have discovered congenial surroundings. At another part of the lake the outflowing water appears clear as crystal; the sediment brought in by the river has manifestly been deposited in the lake, as was the case in our little pool. The marsh at the upper end, of course, is merely another delta, slow growing in this instance, grass-covered, but as surely encroaching on the water area as in the earlier examples. When an entering stream is normally of great transporting power, owing to steep slopes down which it rushes, the form of its delta is not unlike the one first described.

With the data already gathered, we can not escape from the conclusion that the growth going on at the head of the lake will in time,

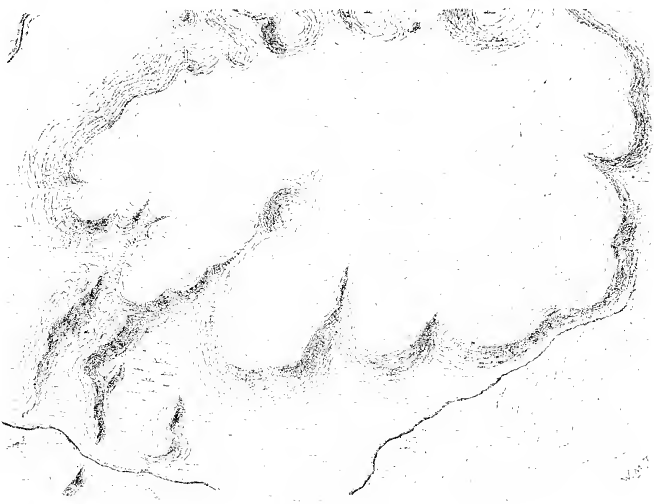


FIG. 4.—A COMMON FORM OF LARGE DELTA.

if present conditions continue to exist, push its way forward until it has occupied the whole water area. The sediment which is now deposited therein will then be transported across the plain, and will be carried along until another body of water is reached. Further search will bring to light the fact that there are plenty of examples showing all stages between the simple delta and the completely filled lake. The innumerable marshes and meadows which characterize the northern part of the United States are fine examples of lakes which have perished in this manner.

Our next excursion will be made to the locality shown in Fig. 4, which is a sketch of a large delta occurring at a considerable height above the general level of the country, although at the present time the delta is not in vicinity of water.* It will be evident to the reader that it differs in no important particular, excepting size, from our little type specimen formed in a pool. Its level top and frontal lobes are to-day nearly as strongly marked as at the time it was made. The reader will have little difficulty in picturing the original conditions of its formation in some ancient lake. This old lake did not endure until the inflowing streams had filled it to a level plain, but for some reason, which it is unnecessary for us to consider, the water was permitted to escape, leaving the delta perched on the valley side. Such deltas are very common, and we find them in all stages, from simple beginnings, as above, to the completed sand plain.

The sand of which our first delta was composed has already been referred to as arranged in horizontal layers. In order to verify our conclusions regarding the origin of this delta, let us seek for an opportunity to observe its internal structure, and to compare it with that observed in the first example. It may happen that the opportunity does not exist at this immediate locality, but a little way off a similar deposit occurs, and a beautiful section has been uncovered by the vigorous attacks of a steam shovel. This section has already been referred to on page 464, as illustrating the structure of the sand layers making up the tiny delta, as well as water deposits in general, and is reproduced here as Fig. 5. The reader will observe in this picture many familiar features common to railroad excavations. The upper part of the geological section thus exposed is somewhat masked by a downfall of sand and loam, and the lower part is also hidden by the same materials. Along the central part, however, the sand and gravel may be seen arranged in horizontal layers of a varying thickness. A close inspection of the uppermost layers will detect a variation in coarseness among the different strata. Such alternations of layers of coarse and fine material are due to differences in the transporting power of the running water that brought the sand and pebbles to their present resting place; the coarse gravel and pebbles were carried by fast-flowing rivers, and the fine sand by streams of less rapidity and consequently less transporting power. Beds of this character ordinarily correspond closely in time with alternating periods of great rainfall or snow melting and the summer seasons. The pebbles of which the coarse layers are composed, as we should expect, are far from spherical, and the operation of gravity on such bodies, as they fall to the floor of a lake or ocean, is to cause them to arrange themselves with their flat surfaces horizontal and parallel to one another. In the

* In order to obtain this sketch, a survey was made of the delta, and from the information thus gathered a model was constructed out of clay. The dimensions of the delta are about one thousand by seven hundred feet.

FIG. 5.—GEOLOGICAL CROSS-SECTION OF A DELTA.

example before us this fact is apparent, and affords the basis for another line of reasoning by which all such stratified deposits, however great their magnitude, are to be referred to the same source—namely, stream-transported materials derived from a decaying and wasting land surface, laid down in water under the influence of gravity.

We have now arrived at a most important and far-reaching generalization so far as the work performed by running water is concerned, and its action in filling our lakes and ponds; and we have learned by observation on a small scale the means by which such deposits may be recognized. Let us apply these means of recognition to the phenomena shown by our large rivers and the more enduring oceans into which they drain. In the same manner that we have studied the little pool and larger lake, we will look into the work done by the great waterways of our continents, selecting as a type of such streams the mighty Mississippi. Careful measurement has shown that this river annually transports two hundred million tons of sediment mechanically suspended. What becomes of this enormous quantity of sand and clay, equal to a cubic mile in a little over a century, as it is swept into the waters of the Gulf of Mexico? For this purpose we have only to visit the region about its mouth to become acquainted with the almost impotent struggles that have been made by our Government during the last fifty years in an effort to keep the river below New Orleans, in part at least, confined to its present channels; and to study the chart of that portion of the Gulf coast prepared by the United States Coast and Geodetic Survey (see Fig. 6). We have not forgotten the little lobes; their method of growth, and the general form of our first-seen delta, shown in Fig. 3. In viewing the phenomena at the mouth of the Mississippi, it is no longer necessary for our present purposes to make a detailed study, since it will become apparent at once that the river is doing the work on a larger scale typified by the performance of the tiny stream flowing into its temporary pool. In place of the little delta with its still smaller lobes, the Mississippi has deposited at its mouth an enormous delta, thousands of square miles in area, and its bifurcating arms may be seen building out several scallops for miles into the waters of the gulf. For centuries these long lobes have been building in advance of the delta front. The arms gradually become clogged with sediment, a new passage to the ocean is opened on the sides, where deposition will begin at a new point, producing a lobe as before. Situated many miles up the river, it is to-day the great fear of New Orleans that its only navigable arm to the sea will thus be closed to that commerce upon which the life of the city depends.

Only a portion of the sediment brought in by the river goes to form its delta; a large part of the finest material, such as clay, is transported by temporary and permanent currents thousands of miles away, where it is deposited in the more quiet waters of the ocean. In this manner the Mississippi has been shown to deposit a cubic mile of mechanically transported material in a little over a century. What shall we say of the effects produced on the continents and oceans by thousands of rivers, each doing its proportionate share of work and acting through millions of years? Two main results must follow, unless interruptions occur: the lower elevations and the magnificent mountain ranges, which rear their lofty heads above the permanent snow line, will be divided into minor peaks; valleys will be carved

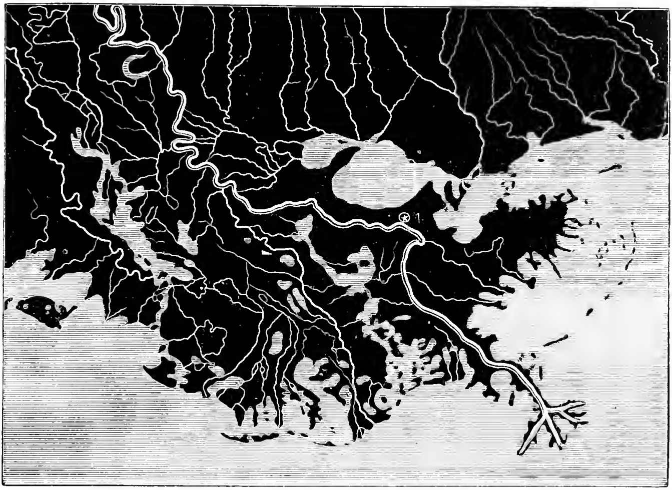


FIG. 6.—THE DELTA OF THE MISSISSIPPI.

out; the whole land surface will slowly waste away, at first rapidly, at last slowly, and be transported to the oceans, where it will form great horizontal beds differing in no essential particular, excepting size, from those shown in Fig. 5—great deposits that are merely deltas on a large scale. The geologist, however, finds no evidence to indicate that at any time in the earth's history have these theoretical results taken place. Land masses, of continental dimensions, have not been allowed thus to waste entirely away to a general flatness on account of the interruptions caused by elevation—the bodily lifting of great areas of rock, even out of the ocean floor, to become mountains or plateaus, in some cases higher than any point in this country. If our observations thus far and those yet to be made serve to make this clear, one of the objects of this article will have been accomplished. It is to be hoped that our observations have made plain the processes of rock disintegration and water transportation; that in the oceans all these materials are eventually deposited in beds horizontally arranged, composed of such products of decay in the condition of sand and mud. We have only to point out the proof that great land masses, composed of water-deposited materials, have been lifted from the ocean to become continents and mountain ranges.

As the ocean deposits slowly accumulate in layers to beds of many thousands of feet in thickness, the lower parts are gradually subjected to greatly increased pressure produced by the overlying beds. During this time waters of a varying temperature, carrying, chemically dissolved, great quantities of lime, silica, and iron oxide, are allowed free circulation through them. These conditions promote chemical change: much silica (the mineral quartz), lesser amounts of carbonate of lime (the mineral calcite), and iron oxide are precipitated about the loose sand grains, firmly cementing them together into a solid rock. A cycle has thus been completed; the dense rocks composing a continent have passed by the process of weathering into incoherent sand and clay, which, when transported to the ocean floor, become again converted into solid rock.

Historical records prove that during the last three thousand years there have taken place many changes in the ocean's level. Old islands have disappeared; new ones have emerged above the surface of the water. Great stretches of seacoast exist at the present time which within the historical period have been covered by the ocean. Even at the present writing we are witnessing the gradual submergence of some parts of the earth and the rising of others; terraces on the northern Atlantic coast may be seen along the hillsides many feet above the present level of the ocean—all of which go to show that the relationship of the land to the water is an unstable one. These are the evidences of continental growth and depressions from the historical standpoint, and the validity of the data upon which the belief is founded can not be shaken. The evidence from the geological side is overwhelming, but before we speak of this it will be well once more to say a word as to the causes of continental uplift.

From an original fluid globe possessing a high temperature, the earth has now cooled down to a degree sufficiently low to permit the formation of a thick rock crust. Underneath this crust an approach to the old surface temperatures is still maintained, and the existence of a certain degree of fluidity is demonstrated to us from time to time by the phenomenon of volcanism. Successive zones of cooling took place. The outer part could only conform to a shrinking interior by wrinkling, folding, or bodily lifting considerable areas above the general level. An adjustment of strains thus set up would take place either with or without folding of the strata. These initial wrinkles gave rise to our first mountains, and the continuation of these conditions at the present time is as surely nourishing mountain growth as at any time in the past. In this way the fluctuations of the ocean's

FIG. 7.—MOUNTAIN SHOWING ROCK FOLDING.

level, above referred to, alone are to be explained, and such form but temporary rises and falls in the history of a continent.

The rate at which an ocean bed is raised to form a mountain range is, no doubt, a variable one; always slow, often interrupted, but seldom or never violent. During this time the strata usually undergo crushing and folding; stretching takes place, and displacements of the rocks, or faulting, are not uncommon. As an example of the wrinkling that the strata may suffer under these conditions, the reader is referred to the beautiful symmetrical fold shown on the side of a mountain in the Appalachians (Fig. 7). Similar folding is the rule, but often immense areas are raised to great heights above the ocean without disturbing the horizontal position of the beds (see Fig. 8). Coincident with the emergence of the rocks from beneath the water, there begin the attacks of the forces operating to destroy them. Hand in hand there go on growth and destruction. The two may keep an even pace; either may obtain the mastery. In the one case, lack of considerable elevation and flatness result; in the other, great altitudes may be attained. The rivers may cut their valleys downward as fast as the land rises, or the down-cutting may be relatively slower. In any case, after a given land mass has attained its greatest height above the sea, the larger rivers soon cut their channels down as far as river cutting is possible—namely, to within a few feet of

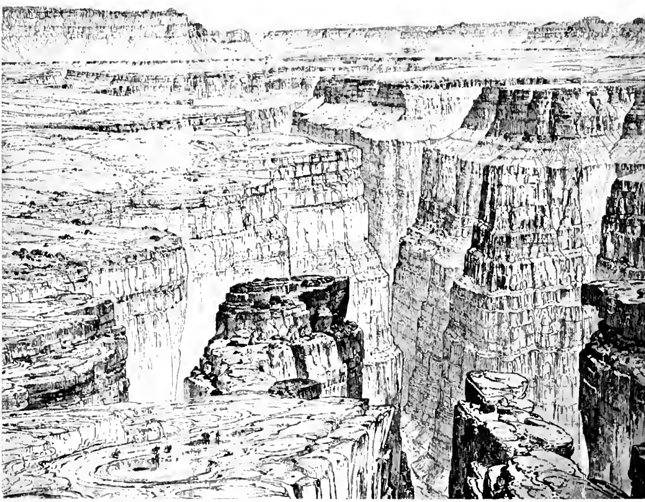


FIG. 8.—HORIZONTAL ROCKS, GRAND CAÑON OF THE COLORADO.

sea level. With relatively rapid elevation, soft rocks, and large rivers, the resultant valley takes the form of a cañon, examples of which are found along the courses of the Colorado and the Yellowstone Rivers (see Fig. 8).* Valleys of this nature soon lose their steep sides by the action of weathering and all that this implies, and pass into a more open state, like that shown in Fig. 9.

These views have been selected in order that a comparison of this type of mountain structure may be made with that shown in Fig.

* The bottom of the cañon at this point is between four and five thousand feet below the flat surfaces in the foreground—a sheer descent of nearly a mile.

Fig. 9.—Mount Stephen, showing its Horizontal Rocks.

6. The points of resemblance between the two sections exposed, one by a steam shovel, the other by river action, are the horizontal position of the strata and the alternations of beds of unlike character. The differences are mainly that the beds making up the mountain show that they are built up of alternating layers of sand (now converted into a sandstone) and clay (now in the condition of a slate). Are not these the products of a decayed continent? Is their position to be explained otherwise than along the lines already stated? Our only difficulty in readily accepting this conclusion is founded on a hereditary belief, born in ignorance and nourished to maturity by superstition, that the earth came into existence as we see it to-day, the surface dissected by valleys in which the rivers find established courses to the sea; possessing a multiplicity of highland and lowland, granite mountains and marble hills, as a result of some plan carried into effect as a creative act. Science has revealed the impossibility of this interpretation. Considered in the light of evolution, acting through an immense period of time, by means of the processes already enumerated, the diversity of land form is made plain to us, and the ever-varying characters of rock structure and composition are in the main made easy of comprehension. Viewed in the light of the foregoing pages, and illustrating as they do land form and the greater part of the earth's crust, the rock structures revealed on the sides of the mountains and cañons, as well as the broader valley itself, take on a new and more intelligent interest. High and enduring as the mountains may appear, resistant as their solid rocks may seem, they are doomed as mountains to the same fate that their own structure and composition prove to have overtaken earlier mountains before them.

The earth has known no cessation in this cycle of decay, deposition, and elevation; again and again have continental masses been raised from the ocean floor only to become a prey to the forces that destroy them. These cycles will continue—mountain ranges will fade away and new ones will be born. A more permanent relationship between the lowland, the upland, and the ocean level will never be attained until the forces that warp and wrinkle the earth's crust shall have ceased forever.

M. Henri Bourget, of the Toulouse (France) Observatory, has called attention in Nature to a common phenomenon which he believes has not been mentioned in any scientific book. If one end of a bar of metal is heated, but not enough to make the other end too hot to be held in the hand, and then suddenly cooled, the temperature of the other end will rise till the hand can not bear it. All workmen who have occasion to handle and heat pieces of metal, he says, know this.

DEATH GULCH, A NATURAL BEAR-TRAP.

By T. A. JAGGAR, Jr., Ph. D.

CASES of asphyxiation by gas have been very frequently reported of late years, and we commonly associate with such reports the idea of a second-rate hotel and an unsophisticated countryman who blows out the gas. Such incidents we connect with the supercivilization of the nineteenth century, but it is none the less true that Nature furnishes similar accidents, and that in regions far remote from the haunts of men. In the heart of the Rocky Mountains of Wyoming, unknown to either the tourist or the trapper, there is a natural hostelry for the wild inhabitants of the forest, where, with food, drink, and shelter all in sight, the poor creatures are tempted one after another into a bath of invisible poisonous vapor, where they sink down to add their bones to the fossil records of an interminable list of similar tragedies, dating back to a period long preceding the records of human history.

It was the writer's privilege, as a member of the expedition of the United States Geological Survey of the Yellowstone Park, under the direction of Mr. Arnold Hague, to visit and for the first time to photograph this remarkable locality. A similar visit was last made by members of the survey in the summer of 1888, and an account of the discovery of Death Gulch was published in Science (February 15, 1889) under the title A Deadly Gas Spring in the Yellowstone Park, by Mr. Walter Harvey Weed. The following extracts from Mr. Weed's paper indicate concisely the general character of the gulch, and the description of the death-trap as it then appeared offers interesting material for comparison with its condition as observed in the summer of 1897.

Death Gulch is a small and gloomy ravine in the northeast corner of the Yellowstone National Park. "In this region the lavas which fill the ancient basin of the park rest upon the flanks of mountains formed of fragmentary volcanic ejecta, . . . while the hydrothermal forces of the central portion of the park show but feeble manifestations of their energy in the almost extinct hot-spring areas of Soda Butte, Lamar River, Cache Creek, and Miller Creek." Although hot water no longer flows from these vents, "gaseous emanations are now given off in considerable volume." On Cache Creek, about two miles above its confluence with Lamar River, are deposits of altered and crystalline travertine, with pools in the creek violently effervescing locally. This is due to the copious emission of gas. Above these deposits "the creek cuts into a bank of sulphur and gravel cemented by this material, and a few yards beyond is the *débouchure* of a small lateral gully coming down from the mountain side. In its bottom is a small stream of clear and cold water, sour with sulphuric acid, and flowing down a narrow and steep channel cut in beds of dark-gray volcanic tuff. Ascending this gulch, the sides, closing together, become very steep slopes of white, decomposed rock. . . . The only springs now flowing are small oozes of water issuing from the base of these slopes, or from the channel bed, forming a thick, creamy, white deposit about the vents, and covering the stream bed. This deposit consists largely of sulphate of alumina. . . . About one hundred and fifty feet above the main stream these oozing springs of acid water cease, but the character of the gulch remains the same. The odor of sulphur now becomes stronger, though producing no other effect than a slight irritation of the lungs.

"The gulch ends, or rather begins, in a scoop or basin about two hundred and fifty feet above Cache Creek, and just below this was found the fresh body of a large bear, a silver-tip grizzly, with the remains of a companion in an advanced stage of decomposition above him. Near by were the skeletons of four more bears, with the bones of an elk a yard or two above, while in the bottom of the pocket were the fresh remains of several squirrels, rock hares, and other small animals, besides numerous dead butterflies and insects. The body of the grizzly was carefully examined for bullet holes or other marks of injury, but showed no traces of violence, the only indication being a few drops of blood under the nose. It was evident that he had met his death but a short time before, as the carcass was still perfectly fresh, though offensive enough at the time of a later visit. The remains of a cinnamon bear just above and alongside of this were in an advanced state of decomposition, while the other skeletons were almost denuded of flesh, though the claws and much of the hair remained. It was apparent that these animals, as well as the squirrels and insects, had not met their death by violence, but had been asphyxiated by the irrespirable gas given off in the gulch. The hollows were tested for carbonic-acid gas with lighted tapers without proving its presence, but the strong smell of sulphur, and a choking sensation of the lungs, indicated the presence of noxious gases, while the strong wind prevailing at the time, together with the open nature of the ravine, must have caused a rapid diffusion of the vapors.

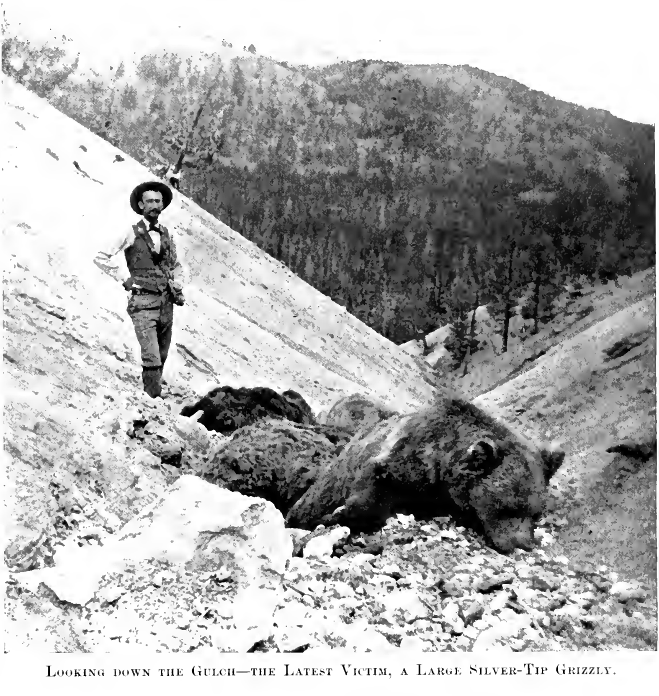
"This place differs, therefore, very materially from the famous Death Valley of Java and similar places, in being simply a V-shaped trench, not over seventy-five feet deep, cut in the mountain slope, and not a hollow or cave. That the gas at times accumulates in the pocket at the head of the gulch is, however, proved by the dead squirrels, etc., found on its bottom. It is not probable, however, that the gas ever accumulates here to a considerable depth, owing to the open nature of the place, and the fact that the gulch draining it would carry off the gas, which would, from its density, tend to flow down the ravine. This offers an explanation of the death of the bears, whose remains occur not in this basin, but where it narrows to form the ravine, for it is here that the layer of gas would be deepest, and has proved sufficient to suffocate the first bear, who

General View, looking downstream, of Lower Part of Death Gulch.

was probably attracted by the remains of the elk, or perhaps of the smaller victims of the invisible gas; and he, in turn, has doubtless served as bait for others who have in turn succumbed. Though the gulch has doubtless served as a death-trap for a very long period of time, these skeletons and bodies must be the remains of only the most recent victims, for the ravine is so narrow and the fall so great that the channel must be cleared out every few years, if not annually. The change wrought by the water during a single rainstorm, which occurred in the interval between Mr. Weed's first and second visits, was so considerable that it seems probable that the floods of early spring, when the snows are melting under the hot sun of this region, must be powerful enough to wash everything down to the cone of *débris* at the mouth of the gulch." Mr. Arnold Hague, on the occasion of his visit, was more successful in obtaining evidence of the presence of carbonic-dioxide gas. He writes: "The day I went up the ravine I was able in two places to extinguish a long brown paper taper. The day I was there it was very calm, and where I made the test the water was trickling down a narrow gorge shut in by shelving rocks above."

It was at noon on the 22d of July in the summer of 1897 that we made camp near the mouth of Cache Creek, about three miles southeast of the military post and mail station of Soda Butte. In company with Dr. Francis P. King I at once started up the creek, keeping the left bank, that we might not miss the gulch, which joins the valley of Cache Creek from the southern side. We had a toilsome climb through timber and over steep embankments, cut by the creek in a loose conglomerate, and after going about a mile and a half we noticed that some of these banks were stained with whitish and yellow deposits of alum and sulphur, indicating that we were nearing the old hot-spring district. Soon a caved-in cone of travertine was seen, with crystalline calcite and sulphur in the cavities, and the bed of the creek was more or less completely whitened by these deposits, while here and there could be seen along the banks oozing "paint-pots" of calcareous mud, in one case inky black, with deposits of varicolored salts about its rim, and a steady ebullition of gas bubbles rising from the bottom. In other cases these pools were crystal clear, and always cold. The vegetation, which below had been dense close to the creek's bank, here became more scanty, especially on the southern side, where the bare rock was exposed and seen to be a volcanic breccia, much decomposed and stained with solfataric deposits. A mound of coarse *débris* seen just above on this side indicated the presence of a lateral ravine, which from its situation and character we decided was probably the gulch sought for. A strong odor of sulphureted hydrogen had been perceptible for some time, and when we entered the gully the fumes became oppressive, causing a heavy burning sensation in the throat and lungs. The ravine proved to be as described, a V-shaped trench cut in the volcanic rock, about fifty feet in depth, with very steep bare whitish slopes, narrowing to a stony rill bed that ascended steeply back into the mountain side.

Climbing through this trough, a frightfully weird and dismal place, utterly without life, and occupied by only a tiny streamlet and an appalling odor, we at length discovered some brown furry masses lying scattered about the floor of the ravine about a quarter of a mile from the point where we had left Cache Creek. Approaching cautiously, it became quickly evident that we had before us a large group of huge recumbent bears; the one nearest to us was lying with his nose between his paws, facing us, and so exactly like a huge dog asleep that it did not seem possible that it was the sleep of



LOOKING DOWN THE GULCH—THE LATEST VICTIM, A LARGE SILVER-TIP GRIZZLY.

death. To make sure, I threw a pebble at the animal, striking him on the flank; the distended skin resounded like a drumhead, and the only response was a belch of poisonous gas that almost overwhelmed us. Closer examination showed that the animal was a young silver-tip grizzly (*Ursus horribilis*); a few drops of thick, dark-red blood stained his nostrils and the ground beneath. There proved to be five other carcasses, all bears, in various stages of decay; careful search revealed oval areas of hair and bones that represented two other bears, making a total of eight carcasses in all. Seven were grizzlies, one was a cinnamon bear (*Ursus americanus*). One huge grizzly was so recent a victim that his tracks were still visible in the white, earthy slopes, leading down to the spot where he had met his death. In no case were any marks of violence seen, and there can be no question that death was occasioned by the gas. The wind was blowing directly up the ravine during our visit, and we failed to get any test for carbonic acid, though we exhausted all our matches in the effort, plunging the flames into hollows of the rill bed in various parts of its course; they invariably burned brightly, and showed not the slightest tendency to extinguish. The dilution of the gas in such a breeze would be inevitable, however; that the gas was present was attested by the peculiar oppression on the lungs that was felt during the entire period that we were in the gulch, and which only wore off gradually on our return to camp. I suffered from a slight headache in consequence for several hours.

There was no difference in the appearance of the portion of the gulch where the eight bears had met their end and the region above and below. A hundred yards or more up stream the solfataric deposits become less abundant, and the timber grows close to the brook; a short distance beyond this the gulch ends. No bodies were found above, and only bears were found in the locality described. It will be observed that Weed's experience differs in this respect from ours, and the appearance of the place was somewhat different: he found elk and small animals in addition to the bears, and describes the death-trap as occupying the mouth of the basin at the head of the gulch, above the point where the last springs of acid water cease. The rill observed by us has its source far above the animals; indeed, it trickles directly through the worm-eaten carcass of the cinnamon bear—a thought by no means comforting when we realized that the water supply for our camp was drawn from the creek only a short distance down the valley.

It is not impossible that there may be two or three of these gullies having similar properties. That we should have found only bears may perhaps be accounted for on the ground that the first victim for this season was a bear, and his carcass frightened away all animals except those of his own family. For an illustration of a process of accumulation of the bones of large vertebrates, with all the conditions present necessary for fossilization, no finer example can be found in the world than Death Gulch; year after year the snow slides and spring floods wash down this fresh supply of entrapped carcasses to be buried in the waste cones and alluvial bottoms of Cache Creek and Lamar River. Probably the stream-formed conglomerate that we noted as we ascended the creek is locally filled with these remains.

The gas is probably generated by the action of the acid water on the ancient limestones that here underlie the lavas at no great depth; outcrops of these limestones occur only a few miles away at the mouth of Soda Butte Creek. This gas must emanate from fissures in the rock just above the bears, and on still nights it may accumulate to a depth of two or three feet in the ravine, settling in a heavy, wavy stratum, and probably rolling slowly down the bed of the rill into the valley below. The accompanying photographs were made during our visit.

THE LABOR PROBLEM IN THE TROPICS.

By W. ALLEYNE IRELAND.

A GREAT deal of space has been devoted in American magazines and newspapers recently to the question of how this country has become a colonial power. Destiny and duty, strength and weakness, accident and design, honesty and corruption have been called on by writers, singly and in various combinations, to bear the responsibility of the new departure in the national policy.

Whatever interest such speculations may possess for the student who seeks to discover in the events of history some indication of the evolution of national character, there can be little doubt that the eyes of the people at large are turned in another direction.

What are our new possessions worth? is the question which intelligent men of all classes are beginning to ask; and it is not surprising, in view of the comparative isolation of this country in the past, that there are few who have sufficient confidence in their own opinion to answer the query.

In England, whose colonial and Indian empire embraces nearly one fourth of the population of the globe, there is an astounding lack of knowledge in relation to colonial affairs; and those who follow the debates in the House of Commons will have noticed that when the colonies are the subject under discussion the few members who remain in their seats seldom fail to exhibit a degree of ignorance which must be most disheartening to the able and learned Colonial Secretary.

It is not to be wondered at, then, that in the United States, where the people have been too much occupied with the problems continually arising at home to pay any attention to affairs which, until very recently, have appeared entirely outside the range of practical politics, there should be few men who have given their time to that careful study of tropical colonization which alone can impart any value to opinions in regard to the practical issues involved in the colonial expansion of this country. Discussion of the subject has been almost entirely along the line of the possible effects of the new policy on the political institutions and popular ideals of the United States, and little has been written which may be said to throw any light on the problem of tropical colonization *per se*.

A residence of ten years in the tropical colonies of France, Spain, Holland, and Great Britain—a period during which I devoted much time to the study of colonial affairs—leaves me of opinion that there are two points in regard to which discussion is peculiarly opportune: 1. The value of the Philippines and Puerto Rico as a field for the cultivation of those tropical products which are consumed in the temperate zones. 2. The value of the islands as a market for products and manufactures of the temperate zones.

It will at once be seen that only in so far as the islands are valuable in the former respect can they be important in the latter, for in the absence of production there can not be any considerable consumption of commodities.

The first point to be considered, and it is the one to which I shall confine myself in the present article, is by what means the productive possibilities of Puerto Rico and the Philippines can be developed.

Basing my calculation on official reports covering a number of years, I find that the average value *per capita* of the annual exports of native products from a number of tropical colonies selected by me for the purpose of this inquiry is as follows:

Trinidad	$26.48	Dominica	$7.28
British Guiana	34.26	St. Vincent	7.68
Martinique	23.48	Ceylon	7.24
Mauritius	20.28	Montserrat	7.89

An examination of these figures will serve to show that the value of the colonies in the first column, measured by the standard of their productiveness, is three times that of the colonies in the second column. Reference to the population returns of the colonies named discloses the fact that in the colonies in the first column the population contains a very large proportion of imported contract laborers and their descendants, while in the other colonies practically the whole population is home-born for at least two generations.

A moment's reflection will show the importance of the comparison instituted above, and if the space at my command permitted a more extensive analysis of the trade of tropical colonies, it could be demonstrated that the theory holds good, almost without exception, that of tropical countries those only are commercially valuable in which a system of imported contract labor is in force.

There are one or two colonies (Barbados is the most striking example) in which the pressure of population is so great that the labor supply suffices for the utmost development of which the country is capable; but such instances are rare.

The experience of England in governing tropical colonies is frequently cited by those who favor the so-called imperial policy for the United States as a proof that tropical colonization in itself presents no difficulties which can not be overcome by enlightened administration. It would be difficult to point out in just what manner Great Britain derives any benefit from her tropical possessions, but her experience confirms the theory I have stated above—that the commercial development of tropical colonies is possible only where there is an extraordinary density of population or where a system of imported contract labor is in force.

A glance through the list of Great Britain's tropical colonies will serve to prove the correctness of this theory. Imported contract labor is used in British Guiana, Trinidad, Jamaica, Queensland, the Fiji Islands, the Straits Settlements, and Mauritius; while the pressure of population is extreme in Lagos and Barbados, which support respectively 1,333 and 1,120 persons to the square mile.

The remaining tropical colonies of Great Britain—using the term "tropical colony" in its strictest sense—are the Gold Coast, Sierra Leone, Gambia, Hongkong, St. Helena, British Honduras, Grenada, St. Vincent, St. Lucia, Antigua, St. Kitts-Nevis, Dominica, Montserrat, and a few islands in the Pacific which are insignificant commercially.

A careful examination of the British trade returns shows that the total export and import trade between the United Kingdom and all the British tropical colonies in 1896 reached a value of $146,000,000, and that of this sum $121,000,000 represented trade with the tropical colonies which employ imported contract labor and with Lagos and Barbados. In other words, the trade between the United Kingdom and those British tropical colonies where free labor is used and where there is no great pressure of population made up less than eighteen per cent of the total trade with the British tropical colonies.

It would appear from the facts I have given that the commercial development of those parts of the tropics where the population is sparse will be dependent on the importation of labor from more densely peopled areas.

If the question is approached from an entirely different standpoint the necessity of contract labor in the tropics becomes more strikingly apparent. The development of the tropics will be in the direction of agriculture rather than manufacturing, and the requirements of tropical agriculture in respect of labor are most arbitrary. It is not sufficient that the labor supply is ample, in the ordinary sense of the word; it must be at all times immediately available.

Thus, a mine owner whose men go out on strike is, briefly, placed in this position: He will lose a sum of money somewhat larger than the amount of profit he could have made during the period of the strike had it not occurred. His coal, however, is still there, and is not less valuable—indeed, in the case of a prolonged strike, may actually be more valuable—when the strike is over; work can easily be resumed where it was dropped, and during the idle days the ordinary running expenses of the mine cease. The greater part of the loss sustained in the instance I have supposed is not out-of-pocket loss, but merely the failure to realize prospective profits.

On the other hand, a sugar estate in the tropics spends about eight months out of the twelve in cultivating the crop, and the remaining four in reaping and boiling operations. By the time the crop is ready to reap many thousands of dollars have been expended on it by way of planting, weeding, draining, and the application of nitrogenous manures. If from any cause the labor supply fails when the cutting of the canes is about to commence, every cent expended on the crop is wasted; and if for want of labor the canes which are cut are not transported within a few hours to the mills, they turn sour and can not be made into sugar. It will thus be seen that in the case of sugar-growing a perfectly reliable labor supply is the first requisite.

The same might be said of the cultivation of tea, coffee, cocoa, spices, and tropical fruits.

This problem—the securing of a reliable labor supply—has been solved in the case of several of the tropical possessions of England by the importation of East Indian laborers under contract to serve for a fixed period on the plantations.

As, in my opinion, the East Indian contract laborer will play an important part in the development of the tropics, I describe in detail the most perfect system of contract labor with which I am acquainted, that existing at the present time in the colony of British Guiana. The system of imported indentured labor which is in force in many of the British colonies has been referred to frequently, both in this country and in England, as "slavery," "semislavery," "the new slavery." The use of such terms to describe such a system indicates a complete ignorance of the facts. As some of the best-informed journals in this country, in noticing my writings on tropical subjects, have fallen into this error, I hope that the description I give here, which is based on several years' experience of the actual working of the system, will serve to convince the readers of this article that the indenture of the East Indian coolie in the British colonies is no more a form of slavery than is any contract entered into between an employer and an employee in this country.

When the British Guiana planter was informed by the home

Government in 1834 that four years later slavery would be entirely abolished throughout the British Empire, he foresaw at once that unless a new source of labor was thrown open a very short time would elapse before the cane fields would fall out of cultivation. He listened, not without some irritation, to the assurances of the agents of the Antislavery Society that as soon as the slaves were freed they would work with redoubled energy, and that the labor supply, instead of deteriorating, would, in fact, improve. The planters knew better, and began at once to arrange for the importation of contract labor. With the year 1834 began the period of apprenticeship for the slaves, prior to their complete emancipation four years later.

During this time, and before the imported labor sufficed for the needs of the plantations, several estates were ruined and fell out of cultivation because the apprenticed laborers would not work.

On October 11, 1838, the governor of the colony, Henry Light, Esquire, issued a proclamation to the freed slaves. The proclamation stated that the governor had learned with regret that the labor of the freed slaves was irregular; that their masters could not depend on them; that they worked one day and idled the next; that when they had earned enough to fill their bellies they lay down to sleep or idled away their time; that they left their tasks unfinished, and then expected to be paid in full for them.

In the meanwhile the planters imported labor from the West Indian Islands, Malta, Madeira, China, and Germany; and eventually the system of immigration from India was organized.

The system is under the control of the Indian Council in Calcutta on the one hand and the British Guiana Government and the Colonial Office on the other. In Georgetown, the capital of the colony, is the immigration department, under the management of the immigration agent general, who has under him a staff of inspectors, subagents, clerks, and interpreters, all of whom must speak at least one Indian dialect. In Calcutta resides the emigration agent general, also an official of the British Guiana Government, who has under him a staff of medical officers, recruiting agents, and clerks.

Each year the planters of British Guiana send in requisitions to the immigration department stating the number of immigrants required for the following year. These requisitions are examined by the agent general, and if, in his opinion, any estate demands more coolies than the extent of its cultivation justifies, the number is reduced. As soon as the full number is decided on, the agent in Calcutta is informed, and the process of recruiting commences. The laborers are secured entirely by voluntary enlistment. The recruiting agents go about the country and explain the terms offered by the British Guiana planters, and those men and women who express their willingness to enter into a contract are sent down to Calcutta at the expense of the colony.

On arrival in Calcutta they are provided with free food and quarters at the emigration depot until such time as a sufficient number are assembled to form a full passenger list for a transport. During the period of waiting, which may extend to several weeks, a careful medical inspection of the laborers is made, and all those who may be deemed unfit for the work of the estates are sent back to their homes at the expense of the colony. Prior to embarkation the coolies are called up in batches of fifteen or twenty, and the emigration agent or a local magistrate reads over to them in their own language the terms of the indenture. Each one is then given an indenture ticket on which the terms of indenture are printed in three dialects. The agent general affixes his signature to each ticket; and a special provision in the laws of British Guiana makes his signature binding on the planters who employ the coolies. The ticket thus constitutes a contract valid as against either party in the courts of the colony.

The coolies have the right to carry with them any children they may wish, and those under twelve years of age are exempt from indenture. The transportation is effected in sailing vessels, which are for the time being Government transports. The reason why steamers are not employed is that sailing vessels are found to be much healthier, and that the long sea voyage has an excellent effect on the immigrants. The regulations governing the voyage are very strict. As far as the coolies are concerned, the ship is in charge of a medical officer. The captain of the ship, the officers, and the crew are all under the command of the doctor, except in so far as the actual sailing of the vessel is in question. The vessel has ample hospital accommodation, a complete dispensary in charge of a qualified dispenser, and all the arrangements must be passed by a Government inspector before the ship is given her clearance. The food to be furnished during the voyage is specified by law. The bill of fare consists chiefly of bread, butter, rice, curry, sago, condensed milk, and fresh mutton, a number of sheep being carried on the ship.

Every morning and evening the doctor makes an inspection of the vessel, and enters in his log-book all essential details, such as births, deaths, cases treated in the hospital, and so forth.

On arrival in the colony the coolies are allotted to the different estates. The coolie is bound to remain for five years on the plantation to which he is allotted, and to work during that time five days a week, the day's work being seven hours. In return for this the planter must furnish him with a house free of rent, and built in such a way as to meet the requirements of the inspector of immigrants' dwellings in regard to ventilation, size, and water supply; and no immigrants are sent to any estate until these houses have been inspected and passed as satisfactory. The planter must also furnish on the estate free hospital accommodation and medical attendance, and in addition provide free education for the children of indentured immigrants.

The medical officers are Government servants, and the colony is divided into districts, each of which has its own doctor, who is compelled by law to visit each estate in his district at least once in forty-eight hours and examine and prescribe for all immigrants presenting themselves at the hospital.

The planter is further bound to pay a minimum daily wage of twenty-four cents to each man and sixteen cents to each woman. This appears at first sight a very small sum, but when it is taken into account that a coolie can live well on eight cents a day it will be seen that the wage is three times the living expense, a rate very rarely paid to agricultural laborers in any part of the world.

That the coolies do, in fact, save considerable sums of money will be seen when the statistics of the immigration department are examined. These records show that during the years 1870 to 1896 38,793 immigrants returned to India after completing their terms of indenture, and that they carried back with them to their native land over $2,800,000. At the end of 1896 there were over five thousand East Indian depositors in the British Guiana Government Savings Bank and the Post-Office Savings Bank, with a total sum of more than $450,000 to their credit.

At the end of five years the indentured coolie becomes absolutely free. He may cease work, or, if he prefer it, remain on the estates as a free laborer. The whole colony is open to him, and he may engage in any trade or profession for which he may be fitted. If he remains for five years longer in the colony, even though he be idle during the whole of that time, he becomes entitled to a grant of land from the Government. The law in this respect has been recently changed. All coolies who came to the colony prior to 1898 have the choice at the end of ten years of a free grant of land or an assisted passage back to their native place.

It may be objected by those persons who are unacquainted with the system that all this sounds very well on paper, but that the opportunities for fraud and oppression must be very frequent, and, human nature being what it is, very frequently taken advantage of, to the injury of the coolies' interests. Such charges have, in fact, been made from time to time, but they have, on investigation, proved to be unfounded, or, at the worst, highly exaggerated. The treatment of the indentured immigrants in British Guiana was the subject of a Royal commission of inquiry in 1870. The appointment of the commission followed a series of charges made by a certain Mr. Des Voeux, a magistrate in the colony, in a letter to Earl Granville, at that time Secretary of State for the Colonies.

The commission visited the colony and conducted a most searching inquiry. Hundreds of witnesses were examined, and the commissioners visited several estates, without giving any warning of their intentions, and questioned many of the coolies as to their treatment. Mr. Des Voeux entirely failed to substantiate his charges; and Sir Clinton Murdoch, the chairman of the emigration board—a permanent department of the Colonial Office—in referring to the report of the commission in a blue book issued in 1872, said: "It may, I think, be considered that the report of the commissioners is generally satisfactory, both as regards the magistracy, the planters, and the immigrants. Many defects in the system and mode of working it are no doubt pointed out, but they are defects caused by errors of judgment, by insufficiency of the law, or by want of foresight, not by intentional neglect or indifference to the well-being of the people, still less by oppression or cruelty. The vindication of the magistracy and of the medical officers appears to be complete, and the fair dealing and kindness of the managers toward the immigrants is acknowledged."

The laws have been amended, the Government inspection has been made more complete, and to-day it is impossible that any abuse of power on the part of the planters can pass unnoticed.

To give an instance of the effectiveness of the Government supervision—each estate is compelled by law to keep pay lists according to a form specified by the immigration department, in which the name of each indentured immigrant must be entered with a record of each separate day's work during the five years of the indenture. Thus, if the pay list shows that in a certain week a man worked only two days out of the legal five, it must also show the reason why he did not work on the other three days. It may have been that the man was in the hospital, in which case the letter "H" must appear opposite his name for those days; or he may have been granted leave of absence, when the letter "L" would account for him. These pay lists are inspected by a Government officer twice a month, and any faults disclosed by the examination become the subject of a severe reprimand from the agent general, followed in the case of persistent neglect by the cutting off of the supply of coolies.

So minute are the records of the immigration department that were an application made to the agent general for information regarding some particular indentured coolie, that official could without difficulty supply the name of the man's father and mother, his caste, age, native place, with the same information in regard to the man's wife. He could also make out an account showing every day the man had worked during the term of his indenture, and the reasons why he had not worked on the other days, with the exact amount earned on each working day. In addition to this he could state how many days the man had spent in the estate's hospital and what was the matter with him on those occasions, besides furnishing a copy of every prescription made up for the man in the estate's dispensary.

A striking evidence of the desire of the Government to protect the coolies from ill treatment of any kind is afforded by the rule of the immigration department that, if any overseer on an estate is convicted of an offense against an indentured immigrant, the dismissal of the offender is demanded, and each estate in the colony is warned that if it employ the man the supply of immigrants will be cut off.

The coolies are given every facility to complain of ill-treatment or breach of contract on the part of the planters, for, in addition to the opportunity afforded by the regular visits of the subagents, the right is secured to them by law of leaving any estate without permission in order to visit the agent general or the nearest magistrate; and either of these officials has the power to issue all process of law free of cost to any coolie who satisfies him that there is a *prima facie* cause of complaint.

Such, in brief, are the features of the East Indian immigration system of British Guiana.*

Those who approach the question of the labor supply for the American colonies with an unprejudiced mind will see that there is

* To those who are interested in the subject of indentured labor in the tropics, the following statistics, compiled by me from official sources, may be of interest. The figures relate to British Guiana:

Year.	Number of indentur'd laborers imported from India	Number of time-expired immigrants who returned to India.	Value in dollars of money and ornaments carried back to India by returning immigrants.	Number of East Indian depositors in the Gov't Savings Bank.	Total amount of their deposits, in dollars.	Number of planters convicted of offenses against immigrants.	Death rate per 1,000 among indentured laborers.	General death rate of the colony.
1886	4,796	1,889	111,775	5,558	425,956	9	27.40	25.56
1887	3,928	1,420	92,613	5,821	438,600	4	23.20	32.41
1888	2,771	1,938	95,074	5,904	457,886	1	19.73	29.27
1889	3,573	2,042	112,124	6,802	513,220	1	12.57	28.13
1890	3,432	2,125	142,611	7,269	558,734	3	20.40	39.80
1891	5,229	2,151	134,225	6,398	515,246	2	20.40	37.00
1892	5,241	2,014	97,529	6,085	527,203	1	25.20	39.00
1893	4,146	1,848	104,763	6,179	544,420	1	24.91	35.00
1894	9,585	1,998	113,308	6,128	529,161	2	24.22	33.53
1895	2,425	2,071	119,289	4,950	453,950	1	20.36	29.58
1896	2,408	2,059	76,470	4,520	434,759	1	16.50	24.10

nothing in the system I have described which is at variance with the principles of the American people.

All that is required to make such a system a boon both to the employer and to the laborer is that the officials charged with the inspection of the system and the protection of the immigrants' interests should be intelligent, honest, and fearless in the discharge of their duties.

PRINCIPLES OF TAXATION.

By the Late Hon. DAVID A. WELLS.

XX.—THE LAW OF THE DIFFUSION OF TAXES.

PART II.

ATTENTION is next asked to an analysis of the incidence of taxation, what is mainly direct, on processes and products, and on the machinery by which one is effected and the other distributed, and at the outset the following propositions in the nature of economic axioms are submitted, which it is believed will serve as stepping stones to the attainment of broad generalizations.

Thus, property is solely produced to supply human wants and desires; and taxes form an important part of the cost of all production, distribution, and consumption, and represent the labor performed in guarding and protecting property at the expense of the State, in all the processes of development and transformation. The State is thus an active and important partner in all production. Without its assistance and protection, production would be impeded or wholly arrested. The soldier or policeman guards, while the citizen performs his labor in safety. As a partner in all the forms of production and business, the State must pay its expenses—i. e., its agents, for their services; and its only means of paying are through its receipts from taxation. Taxes, then, are clearly items of expense in all business, the same as rent, fuel, cost of material, light, labor, waste, insurance, clerical service, advertising, expressage, freight, and the like, and on business principles they find their place on the pages of profit and loss; and, like all other expenses which enter into the cost of production, must finally be sustained by those who gratify their wants or desires by consumption. Production is only a means, and consumption is the end, and the consumer must pay in the end all the expenses of production. Every dealer in domestic or imported merchandise keeps on hand, at all times, upon his shelves, a stock of different and accumulated taxes—customs, internal revenue, State, school, and municipal—with his goods; and when we buy and carry away from any store or shop an article, we buy and carry away with it the accompanying and inherential taxes.

Any primary taxpayer, who does not ultimately consume the thing taxed, and who does not include the tax in the price of the taxed property or its products, must literally throw away his money and must soon become bankrupt and disappear as a competitor; and accordingly the tax advancer will add the tax in his prices if he understands simple addition. How rapidly bankruptcy would befall dealers in imported goods, wares, and merchandise in the United States who did not strictly observe this rule will be realized when one remembers that the average tax imposed by its Government (in 1896) on all dutiable imports is in excess of fifty per cent.

When Dr. Franklin was asked by a committee of the English House of Commons, prior to the American Revolution, if the province of Pennsylvania did not practically relieve farmers and other landowners from taxation, and at the same time impose a heavy tax on merchants, to the injury of British trade, he answered that "if such special tax was imposed, the merchants were experts with their pens, and added the tax to the price of their goods, and thus made the farmers and all landowners pay their part of the tax as consumers."

Taxes uniformly levied on all the subjects of taxation, and which are not so excessive as to become a prohibition on the use of the thing taxed, become, therefore, a part of the cost of all production, distribution, and consumption, and diffuse and equate themselves by natural laws in the same manner and in the same minute degree as all other elements that constitute the expenses of production. We produce to consume and consume to produce, and the cost of consumption, including taxes, enters into the cost of production, and the cost of production, including taxes, enters into the cost of consumption, and thus taxes levied uniformly on things of the same class, by the laws of competition, supply, and demand, and the all-pervading mediums of labor, will be distributed, percussed, and repercussed to a remote degree, until they finally fall upon every person, not in proportion to his consumption of a given article, but in the proportion his consumption bears to the aggregate consumption of the taxed community.

A great capitalist, like Mr. Astor, bears no greater burden of taxation (and can not be made to bear more by any laws that can be properly termed tax laws) than the proportion which his aggregate individual consumption bears to the aggregate individual consumption of all others in his circuit of immediate competition; and as to his other taxes, he is a mere tax collector, or conduit, conducting taxes from his tenants or borrowers to the State or city treasury. A whisky distiller is a tax conduit, or tax collector, and sells more taxes than the original cost of whisky, as finds proof and illustration in the fact that the United States imposes a tax of one dollar and ten cents per gallon on proof whisky which its manufacturer would be very glad to sell free of tax for an average of thirteen cents per gallon. The tax, furthermore, is required to be laid before the whisky can be removed from the distillery or bonded warehouse and allowed to become an article of merchandise. Tobacco in like manner can not go into consumption till the tax is paid. In Great Britain, where all tobacco consumed is imported, for every 3*d.* paid by the consumer, 2.5*d.* represents customs duties or taxes. In Russia it is estimated that the Government annually requires of its peasant producers one third the market value of their entire crop of cereals in payment of their taxes, and fixes the time of collecting the same in the autumn, when the peasant sells sufficient of his grain (mainly for exportation), and with the purchase money meets the demands of the tax collector. Can it be doubted that the sums thus extorted enter into and form an essential part of the cost of the entire crop or product of the land? It is, therefore, immaterial where the process of manufacture takes place; the citizens of a State pay in proportion to the quantity which they consume. The traveler who stops at one of the great city hotels can not avoid reimbursing the owner for the tax he primarily pays on the property; and the owner, in respect to the taxation of his hotel property, is but a great and effective real-estate and diffused tax collector. Again, the farmer charges taxes in the price of his products; the laborer, in his wages; the clergyman, in his salary; the lender, in the interest he receives; the lawyer, in his fees; and the manufacturer, in his goods.

The American Bible Society is always in part loaded with the whisky and tobacco taxes paid by the printers, paper-makers, and bookbinders, or by the producers of articles consumed by these mechanics, and reflected and embodied in their wages and the products of their labor according to the degree of absence of competition from fellow-mechanics who abstain from the use of these and other taxed articles.

These conclusions respecting the diffusion of taxes may be said to be universally accepted by economists so far as they relate to the results of production before they reach the hands of the final consumers; but they are not accepted by many, as Mr. Henry George has recently expressed it, in respect to taxes on special profits or advantages on things of which the supply is strictly limited, or of wealth in the hands of final consumers, or in the course of distribution by gift, and finally in respect to taxes on land. But a little examination would seem to show that all of these exceptions are of the kind that are said to prove the rule. *Special profits* and advantages in this age of quick diffusion of knowledge and intense competition are exceedingly ephemeral, and are mainly confined to results which the State with a view of encouraging removes for a limited time from the natural laws of competition by granting patents, copyrights, and franchises. Of things which are strictly limited in respect to supply, what and where are they? Only a very few can be specified: ivory, Peruvian guano, whalebone, ambergris, and the pelts of the fur seal. Of wealth in the process of transmission, or in the hands of final consumers, it is not *tangible* wealth unless it is *tangible* property, which conforms under any correct system of taxation to the principles of taxation; and if any one advocates the taxation of the right to receive property which has already been taxed, he in effect advocates a double exaction of one and the same thing. If it be asked, Will an income tax on a person retired from business be diffused? the answer, beyond question, must be in the affirmative, if the tax is uniform on all persons and on all amounts, and is absolutely collected in minute sums. Would any one pay the same price for a railroad bond which is subject to an income tax as he would for it if it was free from tax? If one's land is taxed, either in the form of rent or income, will not the tenant have the burden primarily thrown upon him? And, finally, will not the consumer of the tenant's goods pay through or by reason of such consumption?

Respecting the incidence of the tax on mortgages, it does not make any difference how mortgages are taxed—no earthly power can make the lender pay it. If the borrower would not agree to pay the tax, the lender would not loan him money, and whenever possible loans would be foreclosed and payment insisted upon if the borrower should refuse to pay the tax.

Let us next subject to analysis the incidence of the so-called taxation of land. Considered *per se* (or in itself), land, in common with unappropriated air and water, has no value; and it can not in any strict sense be affirmed that we tax land; and when such affirmation is made, its only legitimate and justifiable meaning is that we tax the value of land; which value is due entirely to the amount of personal property (in the sense of embodied labor) expended upon it, and the pressure or demand of such property or labor to use, possess, and occupy it.

Vattel, in his Law of Nations, enunciates as a self-evident and irrefutable proposition that "Nature has not herself established property, and in particular with regard to lands. She only approves this introduction for the advantage of the human race."

One of the most striking examples of evidence in illustration and proof of this proposition is to be found in an incident, which has heretofore escaped attention, which occurred during a debate in the Senate of the United States in 1890 on a bill for revision of duties on imports, in respect to the article borax (borate of soda). Formerly the world's supply of this mineral substance, which enters largely into industrial processes and medicine, was limited, and mainly derived from certain hot springs in Tuscany, Italy; but within a comparatively recent period it has been found that it exists in such abundance in certain of the desert regions of California, Nevada, and Arizona, that it can be gathered with the minimum of labor from the very surface of the ground. Were a single acre of similar desert to be found in any section of a country enjoying the most ordinary privileges in respect to transportation and water supply, it would be a source of wealth to its proprietor. But under existing circumstances, although thousands and thousands of acres of this land can be bought with certain title from its owner—the Federal Government—for two dollars and twenty-five cents an acre, no one wants it at any price; and the prospective demand for it has not yet been sufficient to warrant the Government in instituting even a survey as a preliminary to effecting a sale. In the Senate debate above alluded to it was proposed to increase the duty on imported borax, with the expectation that a consequent increase in its domestic price would afford sufficient profit to induce such construction of roads and such a supply of water and labor on the borax tracts of the deserts as to enable them to become property.*

In the oases of the deserts of North Africa and Egypt the value of a tract of land depends very little upon its size or location, but almost exclusively upon the number of the date-bearing palms, the result of labor, growing upon it, and the quality of their fruit. John Bright on one occasion stated that if the land of Ireland were stripped of the improvements made upon it by the labor of the occupier, the face of the country would be "as bare and naked as an American prairie."

An exact parallel to this state of things is afforded in the case of lands of no value reclaimed from the sea and made valuable, as has been often done in England, Holland, and other countries, by embodying labor upon them in the shape of restraining embankments and the transportation and use of filling material. Again, the value of springs or running streams of water is generally limited and of little account. But when, through direct labor, or the results of labor, the water is collected in reservoirs and made the instrumentality of

* "Senator Paddock: I should like to ask the Senator from Nevada if, in the region of country where borax is found, by reason of finding it the land in the particular State or Territory is appreciated in value on account of its existence.

"Senator Stewart: Not at all.

"Senator Paddock: The value then given to it is all in labor."—*Congressional Record, July, 1890.*

imparting power to machinery, or conducted through conduits to centers of population which otherwise could not obtain it, it becomes extremely valuable, and capable of being sold in large or small quantities. Another similar illustration is to be found in the case of atmospheric air, which in its natural and ordinary state has no marketable value, but when compressed by labor embodied in the form of machinery and made capable of transmitting force, it at once becomes endowed with value and can be sold at a high price.

An opinion entertained and strongly advocated by not a few economic writers and teachers of repute (more especially in Europe, but not in the United States) * is, that taxes on land do not diffuse themselves, but fall wholly on the landowner, and that there is no way in which he can throw it off and cause any considerable part of them to be paid by anybody else. The concrete argument in support of this opinion has been thus stated: "When land is taxed, the owner can not, as a general rule, escape the tax, for the reason that, to get rid of the tax, the price of the land or of the rent must be raised the full amount of the tax, and the only way in which this can be done is by reducing the supply or quantity offered in market, or else by increasing the demand. The supply of land can not be reduced, and the demand being created by capital and population, both of which are beyond the control of the landowner, he can do nothing to raise the price of land, and hence can not get rid of the tax. It may be stated, then, as a general rule, that a tax on land, or on any commodity the supply of which is limited absolutely, must be paid by the owner. It is possible to suggest cases in which, through combination of owners and the necessities of consumers, a demand may be created strong enough to raise the price to the full amount of such tax, but it is doubted if such cases ever really occur." †

The source of the contention on this important economic and social question, and the difficulty in the way of the attainment of harmonious conclusions, is due to a nonrecognition of the fact that land is taxed under two conditions, and can not be taxed otherwise. Thus, if a person holds land for his exclusive use or enjoyment, and consumes all of its product, a tax on such land, which has been characterized by some economists as its "pure rent," will not diffuse

* "In America, where there has been but little serious study of taxation, the few writers of prominence are, remarkable to relate, almost all abject followers of Thiers," the French economist and statesman, who claimed to have invented the term "diffusion" of taxes.

† "Our conclusion is, that under actual conditions in America to-day the landowner may virtually be declared to pay in the last instance the taxes that are imposed on his land, and that at all events it is absolutely erroneous to assume any general shifting to the consumer. In so far as our land tax is a part of a general property tax, it can not possibly be shifted; in so far as it is more or less an exclusive tax, it is even then apt to remain where it is first put—on the landowner."—*Seligman: Incidence of Taxation, p. 99.*

itself, because it is a tax on personal enjoyment or final consumption. The same is the case when a portion of a river or lake or its shore is rented for fishing for the purposes of sport. A like result will also follow, in a greater or less degree, from the inability or unwillingness of tenants, as has been often the case in Ireland, to pay rent sufficient to reimburse the landowner for interest on his investment of capital and cost of repairs. But if one employs land as an instrumentality for acquiring gain through its uses, the taxation of land must include the taxation of its uses—its contents, all that rests upon it, all that is produced, sold, expended, manufactured, or transported on it—and all such taxes will diffuse themselves. On the other hand, if the taxation of land under such circumstances and conditions does not diffuse itself, then the taking is simply a process of confiscation, which if continued will ultimately rob the owner of his property, and is not governed by any principle.

It is indeed difficult to see how a theory so wholly inapplicable to fact and experience as that of the nondiffusion of taxes on land—which makes property in land an exception to the rule acknowledged to be applicable to all other property—could originate and be strenuously maintained to the extent even of stigmatizing any opposite view "as so very superficial as scarcely to deserve a refutation." * No little of confusion and controversy on this subject has arisen from the assumption that land specifically, and the rent of land, constitute two distinct and legitimate subjects for taxation, when the fact is just the contrary. The rent of land is in the nature of an income to its owner; and it is an economic axiom that when a government taxes the income of property it in reality taxes the property itself. In England and on the continent of Europe land is generally taxed on its yearly income or income value, and these taxes are always considered as land taxes. Alexander Hamilton, in discussing the taxation of incomes derived directly from property, used this language: "What, in fact, is property but a fiction, without the beneficial use of it? In many instances, indeed, the income is the property itself." The United States Supreme Court, in its recent decision of the income tax (1895), also practically indorsed this conclusion. To levy taxes on the rent of land and also upon the land itself is, therefore, double taxation on one and the same property, which in common with all other unequal and unjust taxes can not be diffused; and for this reason should be regarded as in the nature of exactions or confiscation, concerning the incidence of which nothing can be safely predicated. In short, this whole discussion, and the unwarranted assumption involved in it and largely accepted, is an illustration of what may be regarded as a maxim, that the greatest errors in political economy

* Seligman. Shifting and Incidence of Taxation.

have arisen from overlooking the most obvious facts or deductions from experience.

With a purpose of further elucidating this problem, attention is asked first to its consideration from an "abstract," and next from a practical standpoint of view. Let us endeavor to clearly understand the common meaning of the word "*rent*." It is derived from the Latin *reddita*, "things given back or paid," and in plain English is a word for price or hire. It may be the hire of anything. It is the price we pay for the right of exclusive use over something which is not our own. Thus we speak of the rent of land, of buildings and apartments, of a fishery, of boats, of water, of an opera box, of a piano, sewing machines, furniture, vehicles, and the like. In Scotland at the present time farmers hire cows to dairymen, who pay an agreed-upon price by the year or for a term of years for each cow, and reimburse themselves for such payment and make a profit on the transaction by the sale of the products of the animal. This hire is called a rent, and is clearly the same in kind as the rent of land. We do not apply the word "hire" to the employment of men, because we have a separate word—"wages"—for that particular case of hire. Neither do we apply the word "rent" in English to the hire of money, because we have another separate word—"interest"—which has come into special use for the price paid for the loan or hire of money. But in the French language the word *rent* is habitually and specially used to signify the price of the hire money, and that of "*rentes*" to investments of money paying interest; the French national debt being always spoken of as "*les rentes*"; while the men who live on the lending of money, or capital in any form, are called "*rentiers*."

The question next naturally arises, Why is it necessary to set up any special theory at all about the natural disposition of the price which we pay for the hire of land, any more than about the price we pay for the hire of a house, of furniture, of a boat, of an opera box, or of a cow? The particular kind of use to which we put each of these various things is no doubt very different from the kind of use to which we put each or all the others. But all of these uses resolve themselves into the desire we have to derive some pleasure or some profit by the possession for a time of the right of exclusive use of something which is not our own, and for which we must pay the price, not of purchase, but of hire.

The explanation of this curious economic phenomenon is to be found in the assumption and positive assertion on the part of not a few distinguished economists that the truly scientific and only correct use of the term "rent" is its application to the "income derived from things of all kinds of which the supply is limited, and can not be increased by man's action." * As a rule, economists who accept this definition confine its application to the hire of land alone, although it professes to include other things, "of all kinds," to which the same description applies—namely, that they can not be increased in quantity by any human action. There are, however, no such other things specified, and in any literal sense there are no such other things existing, unless water and the atmosphere be intended.

Now, although it is indisputably true that man by his action can not increase the absolute or total quantity of land, any more than of water and air, appertaining to the whole globe on which we live, there is practically no limitation to the degree of value which man's action can impart to land, and which is the only thing for which land is wanted, bought, or sold, and which, as already shown, can be truly made the subject of taxation. The tracts of land on the earth's surface which are of no present marketable value are its deserts, its wildernesses, the sides and summits of its mountains, and its continually frozen zones, where no results of labor are embodied in or reflected upon it; while, on the other hand, its tracts of greatest value are in the large cities and marts of trade and commerce, as in the vicinity of the Bank of England, or in Wall Street, where the results of labor are so concentrated and reflected upon land that it is necessary to cover it with gold in order to acquire by purchase a title to it and a right to its exclusive use. The difference between land at twenty-five dollars an acre and twenty-five dollars a square foot is simply that the latter is or may be in the near future covered or surrounded by capital and business, while the former is remote from these sources of value. One of the greatest possible, perhaps probable, outcomes of the modern progress of chemistry is that through the utilization of microbic organizations the value of land as an instrumentality for the production of food may be increased to an extent that at the present time is hardly possible of conception. Again, in the case of air and water, although their total absolute quantity can not be increased, their available and useful quantity in any place, as before shown, can be by the agency of man, and their use made subject to hire or rent.

Consideration is next asked to the question at issue from what may be termed its practical standpoint. We have first a proposition in the nature of an economic axiom, that the price of everything necessary for production, or the hire of anything—land, money, and the like—without which the product could not arise, is, and must be, without exception, a part of the cost of that product; second, that all levies of the State which are worthy of being designated as taxes constitute an essential element of the cost of all products. The rent

* Professor Marshall.

of an opera box, given to obtain a mere pleasure, constitutes a part of the fund out of which the musicians are paid, and if they are not so paid they will not play or sing. The rent given for the right to fish on a certain part of a river or its shores is a part of the cost of producing the fish as a marketable commodity. If a house is hired for the purpose of conducting any business in it, the price of that hire does most certainly enter into the cost of that business, whatever it may be, assuming that the use of the house is a necessity for carrying it on. As no man will produce a commodity by which he is sure to lose money, or fail to obtain the ordinary rate of profit, the tax must be added to the price, or the production will cease. If a uniform tax is imposed on all land occupied, it will be paid by the occupier, because occupation (house-building) will cease until the rent rises sufficiently to cover the tax. The landlord assesses upon his tenants the tax he has paid upon his real estate; each tenant assesses his share upon each of his customers; and so perfect is this diffusion of land taxation that every traveler from a distant part of the country who remains for even a single day at a hotel pays, without stopping to think about it, a portion of the taxes on the building, first paid by the owner, then assessed upon the lessees, and next cut up by them minutely in the *per diem* charge. But of course neither the owner nor lessee really escapes taxation, because a portion of somebody else's tax is thrown back upon them.

Is it possible to believe that in a city like New York, where less than four per cent of its population pay any direct tax on real estate, or in a city like Montreal, where the expenses of the city are mainly derived from taxes on land and the building occupancy of land, the great majority of the inhabitants of those cities are exempt from all land taxation? In China, where, as before shown, the title or ownership of all land vests in the emperor, and the revenue of the Government is almost exclusively derived from taxation of land in the form of rent, does the burden of tax remain upon the owner of the land? If the tax in the form of rent is paid in the products of the land, as undoubtedly it is in part, will not the cost of the percentage of the whole product of the land that is thus taken increase to the renter the cost of the percentage that is left to him; or, if the product is sold for money with which to pay the tax rent, will not its selling price embody the cost of the tax, as it will the cost of every other thing necessary for production? To affirm to the contrary is to say that the price which the Chinese farmer pays for the right of the exclusive use of his land is no part of the crops he may raise upon it.

Consider next the assertion of those who maintain the nondiffusion theory that taxes on land are paid by the owners because the supply of land can neither be increased nor diminished. In answer to it we have the indisputable fact that the owners of land, whenever taxes are increased, attempt to obtain an increased rental for it if the circumstances will permit it. And the very attempt tends to increase the rent. Nothing but adverse circumstances, such as diminishing population or commercial and industrial distress, can prevent a rise in the rental of land on which the taxes are increased; and in the case of dwellings and warehouses the rise is almost always very prompt, because no man will erect new dwellings or warehouses unless their rent compensate fully the increase of taxation. And in any prosperous community, in which population increases in the natural ratio, there must be a constant increase of dwellings and warehouses to prevent a rise of rent, independent of higher wages and higher taxation. In no other occupation is capital surer of obtaining the average net remuneration than in the erection of dwellings and warehouses, and nothing but lack of general prosperity and diminishing population can throw the burden of taxation on real estate or its owners, without the slightest attempt at combination on their part. If the owners of land are not reimbursed for its taxation by its occupants, new houses "would not be erected, the old ones would wear out, and after a time the supply would be so small that the demand would raise rents, and house building begin again, the tax having been transferred to the occupier."

It is pertinent at this point to notice the averment that is frequently made, that cultivators of the soil can not incorporate taxes on the land in the price of their products, because the price of their whole crop is fixed by the price at which any portion of it can be sold in foreign markets. In answer to this we have first the fact that, to give the population of the world an adequate supply of food and other agricultural products, it is not only necessary that all the land at present under cultivation shall continue to be so employed, but further that new lands shall each year be brought under cultivation, or else the land already cultivated shall be made more productive.

The population of the world steadily increases, notwithstanding wars, epidemics, and all the evils which are consequences of man's ignorance and of his improper use of things, his own faculties included. Hence, in case of increased taxation on land, the cultivator of the soil is generally enabled to transfer easily and promptly the burden of the tax to the purchasers of the products he raises, without abandoning the cultivation even of the least productive soil.

Furthermore, the exports of many agricultural products are due not to the cheapness of their cost of production, but to the variations which occur in the productiveness of the crops of other countries. M.

Rouher, a French economist, and for a period a minister of commerce, thoroughly investigated this matter, and proved by incontestable data that almost invariably when the yield of breadstuffs in Europe was large in the country drained by the Black and Baltic Seas, it was small in the countries drained by the Atlantic. This variation in the yield of agricultural crops forces the countries where crops are deficient to purchase from those where they are abundant, or who have a surplus on hand from previous abundant harvests. In the United States, when the harvests are abundant, the American farmers, rather than sell below a certain price, keep a portion of their crops on hand until bad crops in Europe produce a foreign demand, which has to be supplied at once. Under such circumstances those who hold the surplus stock of breadstuffs, or any other product, would control the price, and not the foreigners who stand in need of it. The only check, then, to the cupidity of the holders of breadstuffs is the competition between themselves, which invariably suffices to prevent any undue advantage being taken of the necessities of the countries whose harvests are deficient. These bad crops occur frequently enough to consume all the surplus of the countries that produce in excess of their own wants. In fact, this transient, irregular demand is counted upon and provided for by producers just as much so as the regular home demand—hence is one of the elements that regulate production and control prices.

At this point of the discussion it is desirable to obtain a clear and true idea of the meaning or definition of the phrase "diffusion of taxes." As sometimes used in popular and superficial discussions, it is held to imply that every tax imposed by law distributes itself equitably over the whole surface of society. Such implication would, however, be even more fallacious than an assumption that every expenditure made by an individual distributes itself in such a way that it becomes equally an expenditure by every other individual. On the other hand, a fair consideration of the foregoing summary of facts and deductions would seem to compel every mind not previously warped by prejudice to accept and indorse the following as great fundamental principles in taxation: *First*, that in order to burden equitably and uniformly all persons and property, for the purpose of obtaining revenue for public purposes, it is not necessary to tax primarily and uniformly all persons and property within the taxing district. *Second*, equality of taxation consists in a uniform assessment of the same articles or class of property that is subject to taxation. *Third*, taxes under such a system equate and diffuse themselves; and if levied with certainty and uniformity upon tangible property and fixed signs of property, they will, by a diffusion and repercussion, reach and burden all visible property, and also all of the so-called "invisible and intangible" property, with unerring certainty and equality.

All taxation ultimately and necessarily falls on consumption; and the burden of every man, under any equitable system of taxation, and which no effort will enable him to avoid, will be in the exact proportion or ratio which his aggregate consumption maintains to the aggregate consumption of the taxing district, State, or community of which he is a member.

It is not, however, contended that unequal taxation on competitors of the same class, persons, or things diffuses itself whether such inequality be the result of intention or of defective laws, and their more defective administration. And doubtless one prime reason why economists and others interested have not accepted the law of diffusion of taxes as here given is that they see, as the practical workings of the tax systems they live under, or have become practically familiar with, that taxes in many instances do seem to remain on the person who immediately pays them; and fail to see that such result is due—as in the case of the taxation of large classes of the so-called personal property—to the adoption of a system which does not permit of equality in assessment, and therefore can not be followed by anything of equality in diffusion. Such persons may not unfairly be compared to physicists, who, constantly working with imperfect instruments, and constantly obtaining, in consequence, defective results, come at last to regard their errors as in the nature of established truths.*

* In a like experience the Duke of Argyll, in his work The Unseen Foundations of Society, finds an explanation of the so-called theory of Ricardo, that the rent which a farmer of agricultural land pays as the price of its hire—that is to say, the price which he pays for the exclusive use of it—is no part of the cost of the crops he may raise upon it; a conclusion that can not be possibly true, unless it be also true that rent is paid for something that is not an indispensable condition of agricultural production. "Thus rights are in their very nature impalpable and invisible. They are not material things, but relations between many material things and the human mind and will. The right of exclusive use over land is a thing invisible and immaterial, as other rights are, and, although it is, and has been since the world began, the basis of all agricultural industry, it is a basis impalpable and invisible, whereas the material visible implements and tools, whose work depends upon it, are all visible and palpable enough, and all of which would never be were we to see them without the invisible rights upon which they depend. All of the former, in their place and order, are instruments of production; all of them catch the eye, and may easily engross the attention. On the other hand, if we are induced to forget those other elements, which are equally essential instruments of production, merely because they are out of sight, then our deception may be complete, and fallacies which become glaring when memory and attention are awakened may find in our half-vacant minds an easy and even a cordial reception."

Adam Smith may be fairly considered as having fully committed himself beyond all controversy in his great work, The Wealth of Nations, to the principle that taxes, with a degree of infallibility, diffuse themselves when they are levied uniformly on the same article; and he even goes so far as to admit that a tax upon labor, if it could be uniformly levied

According to these conclusions, the greatest consumers must be the greatest taxpayers. The man also who evades a tax clearly robs his neighbors. The thief also pays taxes indirectly, for he is a consumer, and must pay the advanced price caused by his own roguery for all he consumes, although he does steal the money to pay with. Idlers and even tramps pay taxes, but the amount that they indirectly pay into the fund is much less than they take out of it. People are sometimes referred to or characterized as non-taxpayers, and in political harangues and socialistic essays measures or policies are recommended by which certain persons or classes, by reason of their extreme poverty, shall be entirely exempt from all incidence or burden of taxation. Such a person does not, however, exist in any civilized community. If one could be found he would be a greater curiosity than exists in any museum. To avoid taxation a man must go into an unsettled wilderness where he has no neighbors, for as soon as he has a companion, if that companion be only a dog,

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and collected, would be diffused, and that the laborer would be the mere conduit through which the tax would pass to the public treasury. Thus he says, "While the demand for labor and the price of provisions, therefore, remain the same, a direct tax upon wages can have no other effect than to raise them somewhat higher than the tax."

The German economist Bluntschli, who has carefully studied this question of the final incidence of all just and equitable taxes, is in substantial agreement with the above conclusions, but prefers to use a different term for characterizing such finality than consumption, and expresses himself as follows: "In the end taxes fall on *enjoyments*. Hence the amount of each man's enjoyments and not his income is the justest measure of taxation." (Bluntschli, vol. x, p. 146.)

M. Thiers, the French statesman and economist, was also a believer and earnest advocate of the theory of the diffusion of taxes, and lays down his principles in the following words: "Taxes are shifted indefinitely, and tend to become a part of the price of commodities, to such an extent that every one bears his share, not in proportion to what he pays the state, but in proportion to what he consumes." And in his book Rights to Property he thus illustrates the method in which taxation diffuses itself: "In the same manner as our senses, deceived by appearances, tell us that it is the sun which moves and not the earth, so a particular tax appears to fall upon one class, and another tax upon another class, when in reality it is not so. The tax really best suited to the poorest member of society is that which is best suited to the general fortune of the state; a fortune which is much more for the possession and enjoyment of the poor man than it is for the rich; a fact of which we are never sufficiently convinced. But of the manner, nevertheless, in which taxes are divided among the different classes of the state, the most certain thing we can say is: That they are divided in proportion to what each man consumes, and for a reason not generally recognized or understood, namely, that taxes are reflected, as it were, to infinity, and from reflection to reflection become eventually an integral part of the prices of things. Hence the greatest purchasers and consumers are everywhere the greatest taxpayers. This is what I call '*diffusion of taxation*,' to borrow a term from physical science, which applies the expression 'diffusion of light' to those numberless reflections, in consequence of which the light which has penetrated the slightest aperture spreads itself around in every direction, and in such a manner as to reach all the objects which it renders visible. So a tax which at first sight appears to be paid directly, in reality is only advanced by the individual who is first called upon to pay it."

which he in part or all supports, taxation begins, and the more companions he has, the greater improvements he makes, and the higher civilization he enjoys, the heavier will be the taxes he must pay.

Taxes *legitimately* levied, then, are a part of the cost of all production, and there can be no more tendency for taxes to remain upon the persons who immediately pay them than there is for rents, the cost of insurance, water supply, and fuel to follow the same law. The person who wishes to use or destroy the utility of property by consumption to gratify his desires, or satisfy his wants, can not obtain it from the owners or producers with their consent, except by gift, without giving pay or services for it; and the average price of all property is coincident with the cost of production, including the taxes advanced upon it, which are a part of its cost in the hands of the seller. Again, no person who produces any form of property or utility, for the purpose of sale or rent, sustains any burden of legitimate taxation, although he may be a tax advancer; for, as a tax advancer, he is the agent of the State, and a tax collector from the consumer. But he who produces or buys, and does not sell or rent, but consumes, is the taxpayer, and sustains a tax in his aggregate consumption, where all taxation must ultimately rest. In short, no person bears the burden of taxation, under an equitable, legitimate system, except upon the property which he applies to his own exclusive use in ultimate consumption. The great consumer is the only great taxpayer.

Finally, a great economic law pointed out by Adam Smith, which has an important and almost conclusive bearing upon this vexed problem of the diffusion of taxes, should not be overlooked—namely, his statement in The Wealth of Nations that "*no tax can ever reduce for any considerable time the rate of profit in any particular trade, which must always keep its level with other trades in the neighborhood.*" In other words, taxes and profits, by the operation of the laws of human nature, constantly tend to equate themselves. Man is always prompted to engage in the most profitable occupation and to make the most profitable investment. And since the emancipation from feudalism with its sumptuary laws, legal regulations of the price of labor and merchandise, and other arbitrary governmental invasions of private rights, individual judgment and self-interest have been recognized as the best tests or arbiters of the profitableness of a given investment or occupation. The average profits, therefore, of one form of investment, or of one occupation (as originally shown by Adam Smith), must for any long period equal the average profits of other investments and occupations, whether taxed or untaxed, skill, risk, and agreeableness of occupation being taken into consideration.* Natural laws will, accordingly, always produce an equilibrium of burden between taxed and untaxed things and persons. There is a level of profit and a level of taxation by natural laws, as there is a level of the ocean by natural laws. In fact, all proportional contributions to the State from direct competitors are diffused upon persons and things in the taxing jurisdiction by a uniformity as manifest as is the pressure upon water, which is known to be equal in every direction.

A word here in reference to the popular idea that the exemption of any form of property is to grant a favor to those who possess such property. This idea has, however, no warrant for its acceptance. Thus, an exemption is freedom from a burden or service to which others are liable; but in case of the exclusion of an entire class of property from primary taxation, no person is liable, and therefore there is no exemption. An exclusion of all milk from taxation, while whisky is taxed, is not an exemption, for the two are not competing articles, or articles of the same class. It is true that highly excessive taxation of a given article may cause another and similar article, in some instances, to become a substitute or competing article; and hence the necessity of care and moderation in establishing the rate of taxation. We do not consider that putting a given article into the free list, under the tariff, is an exemption to any particular individual; but if we make the rate higher on one taxpayer or on one importer of the same article than on another taxpayer or importer, we grant an exemption. We use the word "exemption," therefore, imperfectly, when we speak of "the exemption of an entire class of

* As applied to the wages of labor, the truth of this principle is equally incontestable. "The sewing girl performing her toilsome work by the needle at one dollar a day, the street sweeper working the mud with his broom at a dollar and a half, the skilled laborer at two and three dollars, the professor at five, the editor at five or ten, the artist and the songstress at ten or five hundred dollars a day are all members of the working classes, though working at different rates. And it is only the difference in their effectiveness that causes the difference in their earnings. Bring them all to the same point of efficiency, and their earnings also will be the same."—*W. Jungst, Cincinnati.*

John Locke, in his treatise On the Standard of Value, treats of taxation, and shows conclusively that if all lands were nominally free from taxation, the owners of lands would proportionally pay more taxes than now, because the same amount of money must continue to be collected in some form, and the average profits of lands would only be equal to the average profits of other investments; and further, that the expense and annoyance (another form of expense) would be increased if the tax were exclusively levied in the first instance upon personal property; and hence the landowner would be burdened with his proportion of the unnecessary expense and annoyance. He also shows that you may change the form of a uniform tax, but that you can not change the burden; and that the change will increase the burden, if the new system is more expensive and annoying than the old. Locke wrote nearly a century before Adam Smith published his Wealth of Nations, and it would seem probable that Smith acquired his ideas relative to the average profits of investments from Locke.

property," as, for example, upon all personal property; for if the removal of the burden operates uniformly on all interested, or owning such property, then there can be no primary exemption.

THE GREAT BOMBARDMENT.

By CHARLES F. HOLDER.

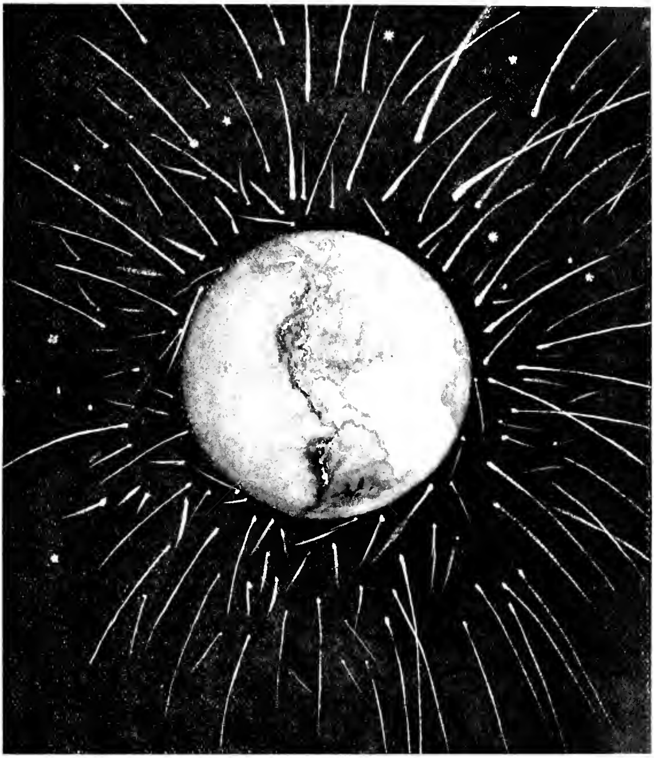
A THIN stratum of air, an invisible armor of great tenuity, lies between man and the menace of possible annihilation.

The regions of space beyond our planet are filled with flying fragments. Some meet the earth in its onward rush; others, having attained inconceivable velocity, overtake and crash into the whirling sphere with loud detonation and ominous glare, finding destruction in its molecular armor, or perhaps ricocheting from it again into the unknown. Some come singly, vagrant fragments from the infinity of space; others fall in showers like golden rain; all constituting a bombardment appalling in its magnitude. It has been estimated that every twenty-four hours the earth or its atmosphere is struck by *four hundred million* missiles of iron or stone, ranging from an ounce up to tons in weight. Every month there rushes upon the flying globe at least twelve billion iron and stone fragments, which, with lurid accompaniment, crash into the circumambient atmosphere. Owing to the resistance offered by the air, few of these solid shots strike the earth. They move out of space with a possible velocity of thirty or forty miles per second, and, like moths, plunge into the revolving globe, lured to their destruction by its fatal attraction. The moment they enter our atmosphere they ignite; the air is piled up and compressed ahead of them with inconceivable force, the resultant friction producing an immediate rise in temperature, and the shooting star, the meteor of popular parlance, is the result.

A simple experiment, made by Joule and Thomson, well illustrates the possibility of this rise in temperature by atmospheric friction. If a wire is whirled through the air at a rate of one hundred and seventy-five feet per second, a rise of one degree, centigrade, will be noticed. If the revolutions are increased to three hundred and seventy-two feet per second, the elevation will be 5.3° C. If the temperature increases as the square of the velocity, a rate of speed

NOTE.—The meteors shown in the two ideal pictures are, of course, entirely disproportionate in size to the earth and stars. If seen by an observer above the earth, we might imagine an envelope of light around the globe from the continuous ignition of the 150,000,000,000 or more meteors which it is estimated strike the earth every year; in which case, the striking meteors would be represented in the illustrations as a thin light line surrounding the atmospheric envelope of the earth.

of twenty miles per second would develop a temperature not far from 360,000° C., which is probably far less than that at the surface of the ordinary meteor as it is seen blazing through our atmosphere. If the meteor is small it is often consumed by the intense heat generated; but larger fragments, owing to their velocity and



IDEAL VIEW OF THE EARTH AS IT IS BOMBARDED BY THE ESTIMATED FOUR HUNDRED MILLION METEORITES EVERY TWENTY-FOUR HOURS.

the fact that they are poor conductors of heat and burn slowly, reach the surface and bury themselves in the sea or earth. But few escape the inevitable consequences of the contact, and of the untold millions which have struck the earth within the memory of man but five hundred and thirty have been seen to fall. The phenomena associated with the plunging meteor is most interesting. A blaze of light, as the terrific heat ignites the iron, announces its entrance into our atmosphere. It may be red, yellow, white, green, or blue, all these hues having been observed. Then follows the explosion, caused by the contact with the air piled up ahead, and in certain instances a loud detonation or a series of noises is heard, which may be repeated indefinitely until the meteoric mass is completely destroyed, and drops, a shower of disintegrated particles, which fall rattling to the ground.

The blaze of light does not continue to the earth, nor does the meteor, should it survive, strike the ground with the velocity with which it entered the atmosphere, as the latter often arrests its motion so completely that it drops upon the earth by its own weight, well illustrated by the meteorites of the Hesslefall, which dropped upon ice but a few inches thick, rebounding as they fell. Thus the atmosphere protects the inhabitants of the globe from a terrific bombardment by destroying many of the largest meteorites, reducing the size of others before they reach the surface and arresting the velocity so that few bury themselves deeply in the soil.

The writer observed a remarkable meteor in 1894. It entered our atmosphere, apparently, over the Mojave Desert, in California, and exploded over the San Gabriel Valley, though without any appreciable sound, and after the first flash disappeared, leaving in the air a large balloon-shaped object of yellow light which lasted some moments, presenting a remarkable spectacle. In this instance the meteor had probably exploded or been consumed, leaving only the light to tell the story, the atmospheric armor of the earth having successfully warded off the blow.

Viewing the facts as they exist, the earth, a seeming fugitive mass flying through space, vainly endeavoring to break the bonds which bind it to the sun, hunted, bombarded with strange missiles hurled from unseen hands or forces from the infinity of space, it is little wonder that the ancients and some savage races of later times invested the phenomena with strange meanings. It requires but little imagination to see in the flying earth a living monster followed by shadowy furies which hurl themselves upon it, now vainly attempting to reach the air-protected body or again striking it with terrific force, lodging deep in its sides amid loud reverberation and dazzling blaze of light.

Meteorites have been known from the very earliest times, and have often been regarded as miraculous creatures to be worshiped and handed down from family to family. The famous meteorite which fell in Phrygia, centuries ago, was worshiped as Cybele, "the mother of the gods," and about the year 204 B. C. was carried to Rome with much display and ceremony, when people of all classes fell down before it, deeming it a messenger from the gods. Diana of Ephesus and the famous Cyprian Venus were, in all probability, meteoric stones which were seen to fall, and were worshiped for the same reason as above. Livy describes a shower of meteorites which fell about the Alban Mount 652 B. C. The senate was demoralized, and certain prophets announced it a warning from heaven, so impressing the lawmakers that they declared a nine-days' festival with which to propitiate the gods. The visitor to Mecca will find enshrined in a place of honor a meteorite which can be traced back beyond 600 A. D., and which is worshiped by pilgrims. The Tartars pointed out a meteorite to Pallas, in 1772, which had fallen at Krasnojarsk, and which they considered a holy messenger from heaven. A large body of meteoric iron found in Wichita County, Texas, was regarded by the Indians as a fetich. They told strangers that it came from the sky as a messenger from the Great Spirit. This meteorite was stationed at a point where two Indian trails met, and was observed and worshiped as a shrine.

The Chinese have records of meteors which fell 644 B. C. The oldest authentic fall in which the stone is preserved is that of Ensisheim, Elsass, Germany, in 1492. The stone, which weighed two hundred and sixty pounds, fell with a loud roar, much to the dismay of the peasantry, penetrating the ground to a depth of five feet. It was secured by King Maximilian, who, after presenting the Duke Sigismund with a section, hung the remainder in the parish church as a holy relic, where, it is said, it may still be seen.

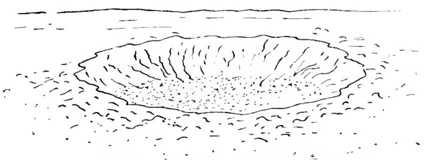
Meteorites vary in size from minute objects not larger than a pea to masses of iron of enormous size. The Chupaderos meteorite, which fell in Chihuahua, Mexico, weighs twenty-five tons. Another, which fell in Kansas, broke into myriads of pieces, the sections found weighing thirteen hundred pounds. A meteorite in the Vienna Museum, which fell in Hungary, weighs six hundred and forty-seven pounds, while the Cranbourne meteorite in the British Museum weighs four tons. The Red River meteorite in the Yale Museum weighs sixteen hundred and thirty pounds. The largest meteorite known was discovered within the Arctic Circle by Lieutenant Peary. The Eskimos had known of it for generations as a source of supply for iron. It was found by Lieutenant Peary in May, 1894, but, owing to its enormous weight, could not be removed until the summer of 1897, when, after much labor, it was excavated and hoisted into the hold of the steam whaling bark Hope and carried to New York, where it has found a resting place in the cabinet of the American Museum of Natural History. It is believed to weigh one hundred tons.

Up to 1772 the stories of bodies falling from space were not entertained seriously by scientific men. So eminent a scientist as Lavoisier, after thoroughly investigating a case, decided that it was merely a stone which had been struck by lightning. Falls finally occurred which demonstrated beyond dispute that the missiles came from space, and science recognized the fact that the earth was literally being bombarded, and that human safety was due to the atmospheric armor, scarcely one hundred miles thick, that enveloped the earth. Instances of the destruction of human life from this cause are very rare. Some years ago a meteorite crushed into the home of an Italian peasant, killing the occupant; and cattle have been known to be destroyed by them; but such instances are exceptional. In 1660 a meteorite fell at Milan, on the authority of the Italian physicist Paolo Maria Tezzayo, killing a Franciscan monk. Humboldt is authority for the statement that a monk was struck dead by a meteorite at Crema, September 4, 1511; and in 1674, on the same authority, a meteorite struck a ship at sea and killed two Swedish sailors.

In December, 1795, at Wold Cottage, in Yorkshire, England, a stone weighing fifty pounds dashed through the air with a loud roar, alarming people in the vicinity, and burying itself in the ground not thirty feet from a laborer. This mass, though undoubtedly traveling, when it struck our atmosphere, at a rate of at least thirty miles a second, was checked so completely that it sank but twelve inches into the soft chalk. Great as is the heat generated during the passage of a meteorite through the air, it does not always permeate the entire body. This was well illustrated in the case of the meteorite which fell at Dhurmsala, Kangra, Punjaub, India, in 1860, fragments of which can be seen in the Field Museum in Chicago. Of it Dr. Oliver C. Farington says: "The fragments were so cold as to benumb the fingers of those who collected them. This is perhaps the only instance known in which the cold of space has become perceptible to human senses."

Some of the individual falls during recent years have attracted widespread attention. One of the most remarkable is known as the Great Kansas Meteor. It was evidently of large size, flashing into sight eighty or ninety miles from the earth, on the 20th of June, 1876, over the State of Kansas. To the first observers it appeared to come from the vicinity of the moon, and resembled a small moon or a gigantic fire ball, blazing brightly, and creating terror and amazement among thousands of spectators who witnessed its flight. It passed to the east, disappearing near the horizon in a blaze of light. The entire passage occupied nearly fifty seconds, being visible to the inhabitants of Iowa, Nebraska, Missouri, Indiana, Wisconsin, Illinois, Michigan, Kentucky, Ohio, Pennsylvania, and West Virginia.

This visitor created the greatest alarm and apprehension along its path, the blaze of light being accompanied by repeated explosions and detonations which sounded like the rumble and roar of cannonading. To some it appeared like the rattling of heavy teams over a rough, rocky road; others believed subterranean explosions accompanied the fall. Horses ran away, stock hurried bellowing to cover, and men, women, and children crouched in fear or fled before the fiery visitor whose roar was distinctly heard several minutes after it had disappeared. As the meteor crossed the Mississippi River the noise of the explosions increased in severity, and were distinctly heard sixty or seventy miles from its path, or a distance of one hundred and forty miles apart. The great ball of flame remained intact as it crossed five or six States, but as it passed over central Illinois loud detonations were heard and the light spread out like an exploding rocket with flashing points. This was the death and destruction of the monster, and from here it dashed on, a stream or shower of countless meteors instead of a solid body, forming over Indiana and Ohio a cluster over forty miles long and five in breadth, showing that while



COON BUTTE, ON SLOPE OF WHICH TEN TONS OF METEORIC IRON HAS BEEN FOUND, AND WHICH WAS SUPPOSED TO HAVE BEEN MADE BY A METEOR.

the meteor had broken up it was still moving with great velocity. How far it traveled is not known, as it was not seen to strike. Observers in Pennsylvania saw it rushing in the direction of New York, and people in that State, where the day was cloudy, heard strange rumblings and detonations. Houses rattled, and the inhabitants along the line the meteor was supposed to have passed accredited the phenomena to an earthquake. Somewhere, perhaps in the forest region of the Adirondacks, or in the Atlantic, lies the wreck of this meteor. But one fragment was found. A farmer in Indiana, while watching its passage heard the thud of a falling object, and going to the spot the following morning found a small meteorite weighing two thirds of a pound.

This marvelous body was first observed in all probability in the northwestern corner of the Indian Territory, possibly sixty or seventy miles above the earth, and from here it dashed along with repeated explosions, almost parallel to the earth's surface, disappearing over New York.

Another remarkable meteor fell into the Atlantic Ocean far out at sea, July 20, 1860. It resembled the one mentioned above in that it was accompanied by a marvelous pyrotechnic display. It first appeared in the vicinity of Michigan, blazing out with a fiery glow that filled the heavens with light. Cocks crowed, oxen lowed, and people

Section of Interior of Coon Butte.

rushed from their homes along its course over the States of New York, Pennsylvania, and New Jersey. When last seen, over the Atlantic, it had separated into three parts, which followed each other as separate fire bodies, without the noise which was the accompanying feature of the Kansas meteor.

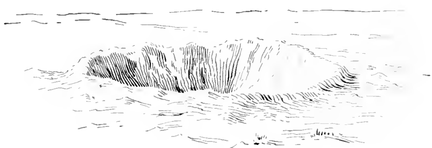
Doubtless the majority of meteors plunge into the ocean, and in modern times several large meteoric bodies have narrowly escaped passing vessels. On December 1, 1896, the officers of the ship Walkomming, bound from New York to Bremen, noticed a large and brilliant meteor flashing down upon them. Its direction was from southeast to northwest, and it plunged into the sea ahead of the vessel with a loud roar and hissing sound; a few minutes later an immense tidal wave, presumably caused by the fall, struck the ship, doing no little damage. Even more remarkable was the escape of the British ship Cawdor, which was given up by the underwriters, but which reached San Francisco November 20, 1897. During a heavy

Section of Coon Butte.

storm, August 20th, a large meteor flashed from the sky and passed between the main and mizzen masts, crashing into the sea with a blinding flash and deafening detonation. For a moment it was thought the ship was on fire, and the air was filled with sulphurous fumes.

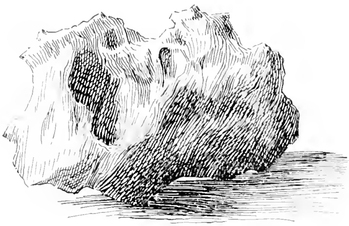
In 1888 a meteor dashed into the atmosphere of the earth and made a brilliant display over southern California. It appeared between twelve and one o'clock in the morning, and shot across the heavens, a fiery red mass—not like the ordinary meteor, but writhing and twisting in a manner peculiarly its own, resembling a huge serpent. When it had passed nearly across the sky it apparently stopped and doubled in the form of a horseshoe, according to the informant of the writer, as large as a half-mile race track. The horseshoe remained visible several minutes, gradually disappearing. The brilliancy of this meteor can be imagined when it is known that the entire San Gabriel Valley was illumined as though an electric light of great power had suddenly been flashed upon it.

Some time in past ages a meteorite weighing at least ten tons shot into our atmosphere and struck the earth near the famous Cañon Diablo in Arizona, the mysterious gulch crossed by the Atchison, Topeka and Santa Fé Railroad. The discovery was made several

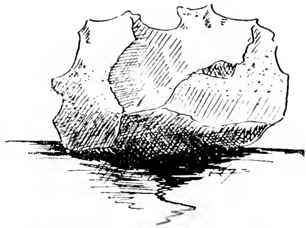


THE CRATER OF COON BUTTE NEAR CAÑON DIABLO, near which the fragments of a meteorite have been found, and which was supposed at one time to have been made by the meteorite.

years ago by a sheep herder, named Armijo. Finding a piece of iron with a peculiar lustrous surface which he believed to be silver, he carried it to one of the towns, where it finally fell into the hands of a geologist, who pronounced it a meteorite. The discovery was followed up, and on the crest and in the vicinity of a singular cone about four thousand feet in diameter pieces of a meteorite were found on the surface, which gave a combined weight of ten tons, in all probability but a fraction of the real monster. The iron masses were widely scattered over the slope and the adjacent *mesa*, and it was assumed that a gigantic meteorite or star had fallen and produced the cone, another striking the earth and forming what is now known as the Cañon Diablo. A large piece of meteoric iron was found twenty miles from the cone; another eight miles east of it; two thousand pieces weighing not over a few pounds or ounces were taken from the slopes; two exceeding a thousand pounds were found within a half mile, while forty or fifty weighing about one hundred pounds were discovered within a radius of half a mile. Here not only a meteor, but a large-sized meteoric shower, had succeeded in penetrating the armor of the earth, leaving many evidences of the extraordinary occurrence which may have been witnessed by the early man of what is now known as Arizona. From the peculiar and interesting evidence a geologist deduced the hypothesis that the crater known as Coon Butte could have been produced by a meteor with a diameter of fifteen hundred feet, and a careful examination with a view of discovering it was made with nicely adjusted mag-



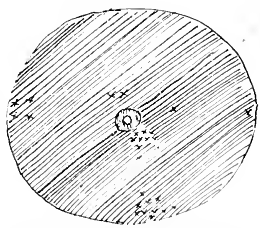
One Hundred and Sixty-one Pound Meteorite. A part of the ten-ton meteorite which fell at Coon Butte, near Cañon Diablo.



One Hundred and Sixty-one and a Half Pound Meteorite found near Crater of Coon Butte.

netic instruments; but in no instance did they indicate the presence of a vast body of metal buried in the earth, and it was assumed that the striking of the crater by the colossal meteorite was a chance blow.

The meteorites or foreign bodies which bombard the earth may be included in three classes—meteoric irons or aërosiderites, meteoric iron stones or aërosiderolites, and meteoric stones, aërolites—all containing elements, about twenty-five in number, which have been found upon the earth. The most conspicuous and important are silicon, iron, nickel, magnesium, sulphur, carbon, and phosphorus, while the others are aluminum, antimony, arsenic, calcium, chlorine, chromium, cobalt, copper, hydrogen, lithium, manganese, oxygen, potassium, sodium, tin, and titanium. Hydrogen and the diamond have also been observed. A number of interesting chemical compounds are found in meteorites not known on the earth, and a study of their character shows that the conditions under which the meteors were formed were entirely different from those which saw the beginning of things terrestrial. In brief, where meteors were born there was an absence of air and water. On the other hand, there was at some stage in the history of meteorites an abundance of hydrogen. The meteoric irons are made up principally of iron with an alloy of nickel, and show a rich crystalline structure, the



Crosses show Large Pieces of the Meteorite found at Coon Butte. (Seven miles in diameter.)

various angles producing a variety of forms known as *Widmanstatten* figures which a few years ago formed the basis of a singular sensation. The figures were supposed to be fossil shells and various animals of a diminutive size which once populated the wrecked world of which the meteor was assumed to be a part. These meteoric animals from space were named and classified by several observers, who were finally forced to acknowledge that their creations were the fanciful markings of crystallization.

Another class of meteorites (meteoric iron stones) may be described as spongy masses of nickeliferous iron in whose pores are found grains of chryosite and other silicates. A type of these bodies is the meteor of Pallas, which was discovered by him in 1772. The third class of meteoric stones are those in which the stony or silicous predominates. As a rule they contain scattered metallic grains, but certain ones, as the aërolite which fell at Gara, France, in 1806, contain metallic constituents.

The aërolites present an attractive appearance when made into sections, showing crystals and splinterlike fragments, and under the glass seem to be made up of many minute spheres ranging from those the size of a cherry down to others invisible to the naked eye. The minerals prominent in their composition are chrysolite, bronzite, augite, enstatite, feldspar, chronite, etc., showing a marked similarity to the eruptive rocks so well known on the earth. The collections of famous meteorites in the various museums of the world have constantly been examined and studied with a view to determine their origin, the question being a fascinating one to layman and scientist. Astronomers in the past have variously answered the question. The flying fragments were believed by some to be the wreckage of other worlds. Planets had perhaps collided and been rent asunder in former ages, and space filled with the flying fragments. Others thought that meteors were molten matter thrown from the earth or moon. All these theories have been relinquished in view of evidence of a more or less convincing character pointing to the conclusion that the bombardment of the earth is one of the results of the disintegration of comets. In other words, cometary matter flying not always blindly through space, but in the orbit of the comet of which it originally formed a part, constituting the missiles.

It is known that the meteors were formed in a region where air and water were absent. It is equally evident that life was not a factor in the past history of the bodies, though it must be acknowledged that the hydrocarbons resembling terrestrial bitumens which are found in some meteorites suggest the possibility of vegetable life. These comets, the mysterious bodies which seem to be roving through space, misconceived planets, as it were, forced into the world half made up, offer the best known solution, as they are literally worlds without air or water, enveloped in a strange and ever-changing substitute for atmosphere; ghostly worlds, which seem to be drawn to the sun, then thrown out into space again to repeat the act until the mighty change from close contact with the fiery mass to the intense cold of distant realms wrecks them, scatters their fragments through the infinity of space where they form gigantic rings or clusters of meteoric matter, raining down upon the sun and planets and all heavenly bodies which meet them, adding fuel to the former, material substance to the latter, and in the case of the moon pitilessly bombarding her crust—illustrating the effect of the bombardment of the earth were it deprived of its atmospheric armor.

The evidence which enabled astronomers to definitely associate comets with meteoric showers and falling stars leads one into a world of romance. Schiaparelli, the distinguished Italian astronomer, made the discovery that meteors had a cometic origin. He had been calculating the orbit and motion of the meteorites which produce the August showers, when it occurred to him that they corresponded with those of a certain comet. By following up this clew it was discovered that the orbit of Tempel's comet corresponded with that of the meteors of the November star shower. The most remarkable evidence was that produced by Biela's comet, discovered in 1826. It had a revolution about the sun of six years and eight months. It was seen in 1772, 1805, 1832, 1845, and 1852. The vast mass, which appeared to be rushing around the sun with remarkable velocity, became separated in 1846, dividing into two parts, one hundred and fifty thousand or two hundred thousand miles from each other. In six years the separation had increased to about one and a half million miles. What mighty cataclysm in infinite space caused this rupture the mind of man can not conceive, but something occurred which rent the aërial giant asunder, and so far as known completed its wreck, as from that time Biela's comet has not been seen. In 1872 the comet was looked for, and astronomers predicted that if it did not appear a shower of stars or meteors would be visible—the remains of the lost traveler through space—and that they would diverge from a point in Andromeda.

This remarkable prediction was verified in every particular. When the moment for the appearance of the comet arrived, November 27, 1872, there burst upon the heavens, not Biela's comet, but a marvelous shower of shooting stars, which dashed down from the constellation of Andromeda as predicted. In 1885 this was duplicated, and the atmosphere was apparently filled with shooting stars. Biela's comet had met disaster in infinite space, and the earth was being bombarded with the wreckage.

It is difficult to comprehend the vastness of these clusters of meteors which constitute the wreck of comets and the source of the principal bombardments. Thus the August stream, which gives us the brilliant displays of summer nights, is supposed to be ten million miles in thickness, as the earth dashing through at a rate of two

THE NOVEMBER SHOWER OF METEORS AT SEA FROM SANDY HOOK.

million miles a day is several days in passing it. We cross the November stream of meteors in a few hours, suggesting a width of forty thousand or fifty thousand miles. This stream of metallic bodies is hundreds of millions of miles in length, and contains myriads of projectiles which may yet be hurled upon the earth or some of the planets of the solar system.

But one piece of Biela's comet, so far as known, was found—a fragment weighing eight pounds falling at Mazapil, Mexico, where it remains one of the most inspiring and interesting of inanimate objects. For years the vast metallic mass, of which this piece formed a part, rushed through space, covering millions of miles; now near the burning surface of the sun, now in regions of space where its heat was scarcely perceptible. For over a century this monster was observed by the inhabitants of the earth, and finally a portion fell and human beings handled and examined it.

The fiery messengers which dash down singly upon the earth, the showers of meteoric stones which flash through our atmosphere with ephemeral gleams, are, then, the remains of gigantic comets which have been seen rushing with apparent erratic course through space, and which by unknown causes have been destroyed and now as meteoric clusters, one of which is estimated to be one billion miles in length and one hundred thousand miles in thickness, and to contain one hundred thousand million meteors, are swinging through space, with many erratic and wandering forms, pouring upon the earth and all the planets of the solar system a mighty and continuous bombardment.

THE SPIRIT OF CONQUEST.

By J. NOVICOW.

THE spirit of conquest produces a gigantic aggregation of calamities and sufferings. A large number of persons still regard conquests with a favoring eye. Now, what does a conquest signify? It is the arming of a band of soldiers and going and taking possession of a territory. Although such expeditions may appear useful, lucrative, legitimate, and even glorious, little regard is paid, in conducting them, to the good of societies; for, in spite of all euphemisms, such military enterprises are robbery, and nothing else, all the time.

Generous spirits who talk about suppressing war do great injury to mankind. Setting themselves in pursuit of a chimera, they abandon the road that leads to concrete and positive results. Realists treat the partisans of perpetual peace as Utopian dreamers, and refuse to follow them. The noblest and most generous efforts are thus wholly lost. The direction of public opinion is left to empirics and retrogrades, to narrow-minded people, who are satisfied with living from day to day and have not the courage to look the social problems of the time in the face. War will never be abolished any more than murder. The propaganda should not be directed on that side. The spirit of conquest is the thing to combat. And this colossal error must be fought not in the name of a vague and intangible fraternity, but by appealing to the egoistic interest of every one. There will always be wars, because man will never be absolutely sound-minded. At times passion and folly will prevail over reason. But the idea that conquest is the quickest means of increasing prosperity will not be everlasting, because it is utterly false.

Man acts conformably to what seems to be his interest. The idea he has of this depends on his judgment, which varies every day, as do also his desires. There is only one efficacious method of effecting social changes: it is, to modify the desires of men, to bring them to seek new objects, different from the old ones.

A great many Germans are saying now, "We would give up the last drop of our blood rather than surrender Alsace-Lorraine." Why do they say that? Because the possession of the provinces annexed in 1871 procures them some sort of real or imaginary satisfaction. But if, on the other hand, this annexation caused them extreme sufferings, the Germans would say, "We would give up the last drop of our blood to get rid of Alsace-Lorraine." Now, if the Germans (or any other people) could comprehend how largely the spirit of conquest diminishes the sum of their enjoyment, they would certainly express themselves in language of the latter sort. The apostles of perpetual peace have therefore taken the wrong road. Their efforts should bear upon the single object of showing that the appropriation of a neighbor's territories in no way increases the welfare of men. The pessimists answer us that it will take many years for the uselessness of conquests to be accepted. Well, then, man shall have to continue many years in suffering; that is all there is of it.

When will the day come that we shall find out that it is no longer advantageous to seize a neighbor's territory? We do not know. The only thing we can affirm with absolute certainty is, that when it arrives our prosperity will be increased five or ten fold.*

This ctesohedonic error (lust for possession) has produced consequences of which we proceed to speak. Just as individuals fancy that they will be better off with larger possessions, so peoples imagine that their prosperity and happiness will be in direct proportion to the territorial extent of their country. Hence one of the silliest aberrations of the human mind—the fatuous idolatry of square miles. A great many Germans still figure it out that they will have a larger

* The pessimists are further mistaken. The idea that conquest is disastrous, even to the conqueror, is much more widespread in modern societies than is generally thought. But social reflexes urge the masses to obey their chief blindly. It requires only a Gothic spirit—like Bismarck, for example—to set a whole army in motion, and make it do things which every officer and every soldier would condemn as a personal act.

sum of happiness if their country contains 208,670 square miles instead of 203,070.* Few errors are more evident. There are thousands of examples to prove that the welfare of citizens is in no way a function of the extent of the state. If it were so, Russia would be the richest country in Europe, while everybody knows it is exactly the contrary. Taxation in that country is pushed to limits that might almost be called absurd, and for that reason the extent of the nation is one of the greatest obstacles to its prosperity.

As an example to illustrate the absurdity of the idolatry of square miles, take California, which now has 158,360 square miles,† and 1,200,000 inhabitants. If in another century the population should rise to forty millions, it might be expedient for the good government of these men to divide the State into several. If the conservatives of that period should declare that they would give the last drop of their blood to preserve the unity of their Commonwealth, they would be afflicted with the square-mile craze, and as foolish as the Europeans. Territorial divisions are made for men, not men for territorial divisions. The object enlightened patriots should pursue is not that a certain geographical extent should be included under one name or many, but that the divisions should conform to the aspirations and desires of the citizens. They should impose as little restraint as possible upon the economical and intellectual progress of societies.

The inhabitants of the province of Rio Grande recently wanted to secede from Brazil. The Government at Rio Janeiro, afflicted like other governments by the square-mile craze, would not consent to it, and hostilities broke out. Suppose the Rio Grandians had been victorious in this war; what would have been the result? There would have been eleven states in South America instead of ten. No modern political theorist would see the presage of an extraordinary calamity in such an event as that. The new state would have been recognized by the other powers, and things would have gone on as before. But if the central Government, respecting the wishes of the Rio Grandians, had consented to the secession, the empirical politicians of our time would have affirmed that the world had been unbalanced. Yet the situation would have been exactly the same in point of territorial divisions—eleven independent states instead of ten. We have then to think that, in the eyes of modern politicians, the avoidance of a war, the fact of sparing hundreds of millions of money and thousands of human lives, diminishes wealth, while the waste of capital and massacres should increase it! It would be hard to be less logical or more absurd.

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* The difference is the extent of Alsace-Lorraine.

† About the extent of the British Isles, Belgium, Holland, and Switzerland combined.

The great North American federation is composed of forty-four States, of from 1,250 square miles (the size of Rhode Island) to 265,780 square miles (the size of Texas). If one hundred States should be established to-morrow of about 30,000 square miles each, there would not necessarily follow either an increase or a diminution of the welfare of the population. The Americans can make equally rapid progress whether divided into forty republics or one hundred, and as slow under one division as under the other. Wealth is not a function of political divisions. So Europe is now divided into twenty-four independent states, having from 8 to 2,100,000 square miles of territory. If it were divided to-morrow into one hundred independent states of 35,000 square miles each, it would as easily be poorer as richer. All would depend upon the interior organization of each of these states, and on the relations which they might establish with one another.

Very few persons understand this truth. When we see the most civilized nations of Europe imagining that their welfare depends on 5,000 or 6,000 square miles more or less, we stand really stupefied before the persistence of the ancient routines. The simple disarmament of three military corps would procure ten times as many benefits for the German people as the possession of Alsace-Lorraine. In short, as long as the false association between the territorial extent of a state and its wealth persists its progress in real wealth will be very slow.

To return to the spirit of conquest. A great many things, as we have shown in another place, are not appropriable. Foreign territories are not so for entire nations. A military chief with his staff may be better off through the conquest of a country, but a nation never.

When William of Normandy seized England he committed an act that was not according to his interest as properly understood. He destroyed by war a considerable quantity of wealth, and he and his barons in turn suffered by the general diminution of welfare. These sufferings were, however, infinitesimal and very hard to appreciate. True views of the nature of wealth were, moreover, not accessible to the brains of men of the eleventh century. Certainly, when William and his army had possessed themselves of England they experienced an increase of wealth that was very evident to them. The king had more revenue; every Norman soldier got land or a reward in money, and he became richer after Hastings than he had ever been before.

But what did the Roman *people*, for example, gain by the conquest of the basin of the Mediterranean? Four or five hundred grand personages divided the provincial lands alienated by the state among themselves, but what benefit did the masses derive from the bloody campaigns of the republic? The distribution of the *annone*, 280 grammes of bread each a day, given to 200,000 persons out of the 1,500,000 inhabitants of the Eternal City! Surely the Romans would have gained a great deal more by working themselves than by pillaging other nations!

Things are exactly the same now. In 1871 twenty-eight persons received from the Emperor William donations forming a total of $3,000,000. But what benefit did the German *people* derive from the conquest of Alsace-Lorraine? None. Dividing the 3,600,000 acres of that province among the 6,400,000 families that were living in Germany at the time of the Treaty of Frankfort would make two and a half acres each. This is not opulence. Of the 5,000,000,000 of francs extorted from France as damage for the expenses of the war there remained 3,896,250,000 francs, which, divided among 6,400,000 families, represent a gain of 609 francs, or about $121.80 per family—hardly enough to live scantily upon for four months; and this was the most lucrative war of which history makes mention! Consider, further, at what amount of sacrifice these $121.80 have been gained. In 1870 the military expenses of the North German Confederation and the four southern states amounted to 349,000,000 francs a year. They now exceed 795,000,000, and in another year (from 1894) will exceed 870,000,000. Here, then, is an increase of 521,000,000 francs, or a charge of 60 francs per family. As 609 francs, even at five per cent, will only return 30 francs, we have here a clear loss of 30 francs (or $6) a family per year. It thus appears that the conquest of Alsace-Lorraine would have been a bad speculation, even if the French indemnity had been distributed in equal parts among all the German families. But, in fact, it has not been so; so that the 60 francs of supplementary expenditure are paid without any compensation.

It might be said that the conquest of Alsace-Lorraine was not dictated solely by sordid economical considerations. Other interests, purer and more elevated, stir the hearts of modern nations. But we ask, Is it grand, noble, and generous to hold unwilling populations under the yoke? On the contrary, it is most base, vile, and degrading. It is difficult to comprehend how brutal conquest can still arouse enthusiasm. Ancient survivals and routines must for a time have suppressed all our reflective faculties.

Suppose, again, 3,000,000 German soldiers should penetrate into Russia and should gain a complete victory: how would they apportion the territory? The parts here would indeed be larger—Russia contains 5,471,500,000 acres. But a third of this territory, at least, is desert; subtracting this, there remain about 3,600,000,000 acres, which, divided among the German families, would give about 5½ acres to each. It may be asked, How will the conquerors take possession of these lands? If each family delegated only one of its members, that would suppose an exodus of 6,400,000 men, going to scatter themselves from the Vistula to the Amoor. What a disturbance so great an emigration would make in the economical condition of Germany! Moreover, would every German colonist be willing to leave his home, his family, his business, and all his cherished associations, to install himself on the banks of the Volga, in Siberia, the Caucasus, or Central Asia? He would acquire 5½ acres, more or less, it is true, but is it certain that that would bring him more than it would take from him? On the other hand, if the Germans should have their shares administered by agents chosen from among the natives, what complications, what annoyances would arise! The Germans might perhaps get rid of these difficulties by selling their lands. But what price could they command, with 3,600,000,000 acres all put into the market at once? Who would buy it? It is only necessary to look at the facts at close range (besides a mass of difficulties we have not spoken of) to comprehend that the direct appropriation of the territory of one great modern nation by individuals of another does not enter into the domain of realizable things.

The appropriation of the landed properties is therefore chimerical. The confiscation of personal goods to the profit of the conquerors also offers insurmountable difficulties. There remain the public riches. Few countries could pay indemnities of 5,000,000,000 francs. But even that colossal sum becomes absurdly insufficient when it is equally divided among millions of takers.

All this is most plainly evident, and yet the spirit of conquest and the fatuous idolatry of square miles are more active than ever in the old world of Europe.

Let us see now what this mad aberration costs. We will begin with the direct losses.

A whole continent of our globe, twice as large as the European continent, having 8,000,000 square miles and 80,000,000 inhabitants—North America—is divided into three political dominions: Canada, the United States, and Mexico. As none of these countries covets the territory of the other, there are on this vast continent only 114,453 soldiers and marines, one military man for 700 inhabitants, while in Europe there is one for 108. The American proportion would give 514,286 men for all the European armies. As there are no savage elements in Europe to be restrained by arms, half of the North American contingent ought to be enough to maintain internal order there. Europe needs only 300,000 soldiers at most; all the others are supported in deference to the idolatry for square miles. This additional military force exceeds 3,300,000 men, and costs 4,508,000,000 francs ($901,600,000) a year. And this is the direct loss entailed by the spirit of conquest; and yet it is trifling as compared with the indirect losses.

First, there are 3,300,000 men under the flags. If they were not soldiers, and were following lucrative occupations and earning only 1,000 francs ($200) a head, they might produce $760,000,000. The $900,000,000 absorbed now by military expenditures would bring five per cent if invested in agricultural and industrial enterprises. This would make another $45,000,000. The twenty-eight days of the reserves are worth at least $40,000,000. Here, then, is an absolutely palpable sum of $845,000,000. But what a number of colossal losses escape all valuation! Capital produces capital. If $1,800,000,000 were saved every year from military expenses and poured into industrial enterprises, they would produce benefits beyond our power to estimate.

To obtain a correct appreciation of the evils derived from the spirit of conquest, we must take a glance at the past. We need not go back of the middle ages, from which we shall only take a few examples. The destruction of wealth wrought by war has been nowhere so frightful as in Spain. In 1073 the Castilians tried to capture Toledo from the Moors. With the military engines of the time it was impossible to accomplish the purpose by a direct attack on a place so admirably fortified by Nature and man; so the King of Castile, Alfonso VI, ravaged the country for three successive years, destroyed the crops, harassed the people and the cattle, and, in short, made a desert around the old capital of the Visigoths.

From 1110 till 1815—seven hundred and five years—there were two hundred and seventy-two years of war between France and England. Now the two nations have lived in peace for eighty years, and it has not prevented them from prospering. What better proof could we have that all the previous wars were useless?

We need not speak of the massacres of the Thirty Years' War, by which a third of the population of Germany perished, or of the frightful hecatombs of Napoleon I, for these facts are in everybody's memory. We shall confine our attention to the losses caused by the spirit of conquest, at least since the Thirty Years' War. Here, again, we shall proceed by analogies. From 1700 to 1815 England expended 175,000,000 francs ($35,000,000) a year for war. Suppose that the expenditures of the other great powers—Germany (including Prussia), Austria, Spain, France, and Russia—were similar. This would make, without counting the smaller states, 1,050,000,000 francs ($210,000,000) for all Europe. Still, as war was not so costly to Russia or Prussia as to England, we will reduce this figure one fourth. We shall then have, between 1700 and 1815, an annual expenditure of 787,500,000 francs ($157,500,000).* Let us estimate the cost of the wars of the seventeenth century at a slightly lower sum, putting it at only 500,000,000 francs (or $100,000,000) a year for all Europe. That would make 41,000,000,000 francs ($8,200,-000,000), or for the entire period from 1618 to 1815, 131,562,-500,000 francs ($26,312,500,000).

We have more certain data for the nineteenth century. The Crimean, Italian, Schleswig-Holstein, and American Wars, and the war of 1866, cost 46,830,000,000 francs ($9,366,000,000).† The war of France cost 15,000,000,000 francs ($3,000,000,000) at the lowest; that of 1877 at least 4,000,000,000 francs ($800,000,000). Add for the war of Greek independence, the French and Austrian expeditions to Spain and Naples, the Polish war of 1830, the Turco-Russian war of 1828–'29, and the wars of 1848, 3,000,000,000 francs ($600,000,000) more—a very moderate estimate; we reach a total sum of 68,830,000,000 francs ($13,766,000,000). None of the extra-European conflicts are comprised in this figure; neither the war between Russia and Persia in 1827, that of Mehemet Ali against the Turks, the struggle against the mountaineers of the Caucasus and against the Arabs in Algeria, or the English campaign in Afghanistan—concerning all of which we have no figures.

Counting only the figures we have been able to obtain, we have for the period from 1618 till our own days 200,392,000,000 francs ($50,078,500,000) as the bare direct losses by war, which have had to be defrayed by the budgets of the different European states. How shall we calculate the indirect losses? Between 1618 and 1648 Germany lost 6,000,000 inhabitants. The destruction of property was prodigious, the ravages were frightful. How can we represent them in money? It is absolutely impossible. There are, too, some expenses arising from the spirit of conquest that almost wholly escape observation. We shall give only two examples of them.

The ctesohedonic fallacy (lust for possession) raged in the middle ages between the nearest neighbors. No city could offer any security unless it was surrounded by strong walls. Since these required great expenditures, they could not be rebuilt every few days. For this reason space was greatly economized in the cities, and their streets were very narrow. At a later period, when security had become

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* See Seeley's Expansion of England, p. 21. This figure is very moderate. Between 1802 and 1813 France alone spent 498,000,000 francs ($99,600,000) a year. See Laroque, La Guerre et les Armées permanentes, Paris, 1870, p. 203.

† See P. Leroy-Beaulieu, Recherches économiques sur les Guerres contemporaines, Paris, p. 181.

established, the walls were demolished. In our own time the needs of hygiene and luxury have urged the opening of broad ways in the ancient European cities. It has been necessary to buy houses and demolish them in order to create the grand modern avenues. There would have been no walls in the middle ages except for the spirit of conquest, and the broad streets would have been established then, as has been done in the new cities of Russia and America. To pierce these new avenues, Paris, for example, has had to contract debts, the annual interest on which amounts to at least 50,000,000 or 60,000,000 francs ($10,000,000 to $12,000,000). This expense should be charged to the account of the spirit of conquest. But nobody has ever thought of attributing these 50,000,000 or 60,000,000 of the city budget to military waste. And how many other cities are in the same situation? Another example: during six centuries France and England were trying to take provinces from one another. Hence a permanent hostility existed between the two nations. Later on the circumstances changed, but by virtue of the routine inherent in the human mind the old resentments remained, though the motive for them had gone. To thwart the progress of France was considered a patriotic duty by such English ministers as Lord Palmerston. In 1855 M. de Lesseps formed a company to construct the Suez Canal. As M. de Lesseps was a Frenchman, Lord Palmerston and the British Cabinet thought themselves obligated to oppose his project, and their opposition cost about 200,000,000 francs ($40,000,000). The canal might have been constructed then for that sum, but in consequence of the machinations of the English it cost 400,000,000 francs ($80,000,000). Who has ever thought of charging that loss to the account of the spirit of conquest? Nevertheless, that is where it belongs.*

The indirect losses of war defy valuation. But the matter may be looked at from another point of view: that of the profits which they prevent being made. The American war against secession cost the treasury of both combatants $7,000,000,000. Now, if, without speaking of the destruction of property,† we only consider the benefits nonrealized, the most moderate estimates make them

* We may refer here to another loss which has never been thought of till now. It was long fancied that wealth could be acquired more rapidly by war than by work; consequently, conquest seeming to be the most rapid and therefore most efficacious way, was honored, and labor, appearing to be a slower process, was despised. In our days a large number of descendants of the knights of the middle ages retain the ideas of their ancestors and look upon labor as degrading. Hence thousands of aristocrats do nothing, but remain social good-for-nothings, retarding the increase of wealth by their inactivity.

† Sherman, in his march from Atlanta to Savannah alone, destroyed more than $400,000,000. The cotton famine occasioned by this war cost Great Britain a loss of $480,000,000. Who has ever thought of charging this against militarism?

$12,000,000,000 for the year 1890,* and the figure goes on every year increasing in geometrical progression.

Further, the debts must be considered. The largest proportion of them are consequences of the idolatry for square miles. This entails an annual expenditure of $644,800,000 which we should not have to bear were it not for the ctesohedonic fallacy.†

Yet another factor has so far not been mentioned: men. The wars of the last three centuries have cost, at the lowest figure, 30,-000,000 or 40,000,000 victims. Some authors raise this very moderate estimate to 20,000,000 per century. Without speaking of the frightful sufferings of these unfortunates, they represent an enormous capital.‡ Let us add, further, that these men, if they had not been killed, might have had children that now have no existence. Without the wars of Napoleon I and Napoleon III Europe would have had 45,000,000 more inhabitants than it has, and they might have been producing $2,700,000 a year.#

We hope the reader will admit, after these considerations, that the indirect losses of war certainly exceed the direct ones. Still, adhering to our method of underrating rather than exaggerating, we will regard them as equal. We may therefore affirm that the spirit of conquest has cost, since 1618, in the group of European nations alone, the trifle of $80,156,800,000. Suppose we should go farther back—into antiquity even? Imagination refuses to set down the gigantic sums.

This is not all; the cost of civil wars has to be counted, for the conquest of power within the state is attended by massacres which are often not inferior to those of foreign ones. The chiefs of the Roman legions contending for the empire carired on as bloody and costly campaigns against their rivals as against the Parthians or the Germans. The war between Paris and Versailles in 1871 occa-

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* See E. Reclus, Nouvelle geographie universelle (French edition), vol. xvi, p. 810.

† A justification of this figure may be found in my Luttes entre les sociétés humaines, p. 220.

‡ A half million negroes are massacred every year in Africa in the tribal wars, which also are caused by the ctesohedonic fallacy. Suppose each one of them might have earned $20 a year. Capitalized at four per cent, this sum would have amounted to $400,000,000.

\# See my Luttes, p. 228. Let us say, in passing, that we owe our existing savagery partly to the ctesohedonic fallacy. When we think that the most rapid way of enriching ourselves is by seizing our neighbor's territories, the fewer defenders that territory has, the better. So all pretended political geniuses glorify themselves on having killed the largest number of their fellow-men. Cæsar boasted of having killed a million and a half of Gauls. At the moment of writing these lines a terrible accident has occurred at Santander. Hundreds of persons were killed by the explosion of a boat loaded with dynamite. Great pity was expressed for the victims. Collections for their benefit were taken in France. Suppose France and Spain were now at war. If somebody had blown up some thousand Spaniards in a fortress, we should have sung *Te Deums*. Oh, man's logic!

sioned considerable expenditures, not to speak of the indirect losses, which were immense. We are, unfortunately, absolutely without data concerning the cost of civil wars, and shall have to satisfy ourselves with what we have been able to obtain concerning foreign wars. $80,156,800,000 used up in two centuries! We need not go outside of this for a solution of the social question. Without this unrestricted waste the earth would now have ten times more wheat, sugar, linen, cotton, meat, wool, etc.; there would be ten times as many houses on the globe, and they would be more spacious, better warmed, and better ventilated; a network of roads, with frequent mails, would cover Europe, Asia, Africa, and America. In short, if conquest had been considered an evil, even during only two centuries, our wealth would have been infinitely superior to what we now possess. But if the ctesohedonic fallacy had been seen through by the civilized societies of the Roman period, the face of the earth would have been very different from what it is. Our planet would have been completely appropriated to the satisfaction of our wants. Waste lands would have been tilled and swamps dried; everywhere that a drop of water could be made to serve for irrigation it would have been applied to that use. Magnificent cities, inhabited by active and industrious populations, would have arisen in numerous places where now are found only briers and stones. In short, we should have been able to see men now, in the year of grace 1894, as we expect to see them in three or four thousand years.

The past can not be changed. We have laid bare the unhappy consequences of our ancient errors simply in order to show how we can assure our welfare in the future. As long as the spirit of conquest rages among men, misery will be the lot of our species. Our savage and barbarous ancestors did not know what we know. Attila, Tamerlane, and even Matabele, a chief of our own times, might be excused for fancying that conquest increases the wealth of the conquerors; but a Moltke and a Prince Bismarck can not. The masses are still too deeply imbued with military vainglory. Happily, they are beginning to open their eyes.—*Translated for the Popular Science Monthly from the book Les Gaspillages des Sociétés Modernes* (The Wastes of Modern Societies), Paris, 1894.

Until within a few years the field for the study of glaciers and their action has been the Alps; but now, as Prof. H. L. Fairchild said in his address as chairman of the Geological Section of the American Association, the North American continent is recognized as a field of the greatest activity, both in the past and at the present time; and, moreover, it presents types of glaciers not known in Europe. It must therefore become the Mecca of foreign students of glaciers.

A SHORT HISTORY OF SCIENTIFIC INSTRUCTION.*

By J. NORMAN LOCKYER, K.C.B., F.R.S.

II.

I MUST come back from this excursion to call your attention to the year 1845, in which one of the germs of our college first saw the light.

What was the condition of England in 1845? Her universities had degenerated into *hauts lycées.* With regard to the university teaching, I may state that even as late as the late fifties a senior wrangler—I had the story from himself—came to London from Cambridge expressly to walk about the streets to study crystals, prisms, and the like in the optician's windows. Of laboratories in the universities there were none; of science teaching in the schools there was none; there was no organization for training science teachers.

If an artisan wished to improve his knowledge he had only the moribund Mechanics' Institutes to fall back upon.

The nation which then was renowned for its utilization of waste material products allowed its mental products to remain undeveloped.

There was no minister of instruction, no councilors with a knowledge of the national scientific needs, no organized secondary or primary instruction. We lacked then everything that Germany had equipped herself with in the matter of scientific industries.

Did this matter? Was it more than a mere abstract question of a want of perfection?

It mattered very much! From all quarters came the cry that the national industries were being undermined in consequence of the more complete application of scientific methods to those of other countries.

The chemical industries were the first to feel this, and because England was then the seat of most of the large chemical works.†

Very few chemists were employed in these chemical works. There were in cases some so-called chemists at about bricklayer's wages—not much of an inducement to study chemistry; even if there had been practical laboratories, where it could have been properly learned. Hence, when efficient men were wanted they were got from abroad—i. e., from Germany, or the richer English had to go abroad themselves.

At this time we had, fortunately for us, in England, in very high place, a German fully educated by all that could be learned at one of

* An address delivered at the Royal College of Science on October 6, 1898.

† Perkin. Nature, vol. xxxii, p. 334.

the best-equipped modern German universities, where he studied both science and the fine arts. I refer to the Prince Consort. From that year to his death he was the fountain of our English educational renaissance, drawing to himself men like Playfair, Clark, and De la Beche; knowing what we lacked, he threw himself into the breach. This college is one of the many things the nation owes to him. His service to his adopted country, and the value of the institutions he helped to inaugurate, are by no means even yet fully recognized, because those from whom national recognition full and ample should have come, were, and to a great extent still are, the products of the old system of middle-age scholasticism which his clear vision recognized was incapable by itself of coping with the conditions of modern civilized communities.

It was in the year 1845 that the influence of the Prince Consort began to be felt. Those who know most of the conditions of science and art then and now, know best how beneficial that influence was in both directions; my present purpose, however, has only reference to science.

The College of Chemistry was founded in 1845, first as a private institution; the School of Mines was established by the Government in 1851.

In the next year, in the speech from the throne at the opening of Parliament, her Majesty spoke as follows: "The advancement of the fine arts and of practical science will be readily recognized by you as worthy the attention of a great and enlightened nation. I have directed that a comprehensive scheme shall be laid before you having in view the promotion of these objects, toward which I invite your aid and co-operation."

Strange words these from the lips of an English sovereign!

The Government of this country was made at last to recognize the great factors of a peaceful nation's prosperity, and to reverse a policy which has been as disastrous to us as if they had insisted upon our naval needs being supplied by local effort as they were in Queen Elizabeth's time.

England has practically lost a century; one need not be a prophet to foresee that in another century's time our education and our scientific establishments will be as strongly organized by the British Government as the navy itself.

As a part of the comprehensive scheme referred to by her Majesty, the Department of Science and Art was organized in 1853, and in the amalgamation of the College of Chemistry and the School of Mines we have the germ of our present institution.

But this was not the only science school founded by the Government. The Royal School of Naval Architecture and Marine Engineering was established by the department at the request of the Lords Commissioners of the Admiralty, "with a view of providing especially for the education of shipbuilding officers for her Majesty's service, and promoting the general study of the science of shipbuilding and naval engineering." It was not limited to persons in the Queen's service, and it was opened on November 1, 1864. The present Royal College of Science was built for it and the College of Chemistry. In 1873 the school was transferred to the Royal Naval College, Greenwich, and this accident enabled the teaching from Jermyn Street to be transferred and proper practical instruction to be given at South Kensington. The Lords of the Admiralty expressed their entire satisfaction with the manner in which the instruction had been carried on at South Kensington; and well they might, for in a memorandum submitted to the Lord President in 1887, the president and council of the Institute of Naval Architects state: "When the department dealt with the highest class of education in naval architecture by assisting in founding and by carrying on the School of Naval Architecture at South Kensington, the success which attended their efforts was phenomenal, the great majority of the rising men in the profession having been educated at that institution."

Here I again point out, both with regard to the School of Mines, the School of Naval Architecture, and the later Normal School, that it was stern need that was in question, as in Egypt in old times.

Of the early history of the college I need say nothing after the addresses of my colleagues, Professors Judd and Roberts-Austen, but I am anxious to refer to some parts of its present organization and their effect on our national educational growth in some directions.

It was after 1870 that our institution gradually began to take its place as a normal school—that is, that the teaching of teachers formed an important part of its organization, because in that year the newly established departments, having found that the great national want then was teachers of science, began to take steps to secure them. Examinations had been inaugurated in 1859, but they were for outsiders, conferring certificates and a money reward on the most competent teachers tested in this way. These examinations were really controlled by our school, for Tyndall, Hofmann, Ramsay, Huxley, and Warington Smyth, the first professors, were also the first examiners.

Very interesting is it to look back at that first year's work, the first cast of the new educational net. After what I have said about the condition of chemistry and the establishment of the College of Chemistry in 1845, you will not be surprised to hear that Dr. Hofmann was the most favored—he had forty-four students.

Professor Huxley found one student to tackle his questions, and he failed.

Professors Ramsay and Warington Smyth had three each, but the two threes only made five; for both lists were headed by the name of

Judd, John W.,
Wesleyan Training College,
Westminster.

Our present dean was caught in the first haul.

These examinations were continued till 1866, and upward of six hundred teachers obtained certificates, some of them in several subjects.

Having secured the teachers, the next thing the department did was to utilize them. This was done in 1859 by the establishment of the science classes throughout the country, which are, I think, the only part of our educational system which even the Germans envy us. The teaching might go on in schools, attics or cellars, there was neither age limit nor distinction of sex or creed.

Let me insist upon the fact that from the outset practical work was encouraged by payments for apparatus, and that latterly the examinations themselves, in some of the subjects, have been practical.

The number of students under instruction in science classes under examined in the first year in which local examinations were held was 442; the number in 1897 was 202,496. The number of candidates examined in the first year in which local examinations were held was 650, who worked 1,000 papers; in 1897 the number was 106,185, who worked 159,724 papers, chemistry alone sending in 28,891 papers, mathematics 24,764, and physiography 16,870.

The total number of individual students under instruction in science classes under the department from 1859 to 1897 inclusive has been, approximately, 2,000,000. Of these about 900,000 came forward for examination, the total number of papers worked by them being 3,195,170.

Now why have I brought these statistics before you?

Because from 1861 onward the chief rewards of the successful students have been scholarships and exhibitions held in this college; a system adopted in the hope that in this way the numbers of perfectly trained science teachers might be increased, so that the science classes throughout the country might go on from strength to strength.

The royal exhibitions date from 1863, the national scholars from 1884. The free studentships were added later.

The strict connection between the science classes throughout the country and our college will be gathered from the following statement, which refers to the present time:

Twenty-one royal exhibitions—seven open each year—four to the Royal College of Science, London, and three to the Royal College of Science, Dublin.

Sixty-six national scholarships—twenty-two open each year—tenable, at the option of the holder, at either the Royal College of Science, London, or the Royal College of Science, Dublin.

Eighteen free studentships—six open each year—to the Royal College of Science, London.

A royal exhibition entitles the holder to free admission to lectures and laboratories, and to instruction during the course for the associateship—about three years—in the Royal College of Science, London, or the Royal College of Science, Dublin, with maintenance and traveling allowances.

A national scholarship entitles the holder to free admission to lectures and laboratories and to instruction during the course of the associateship—about three years—at either the Royal College of Science, London, or the Royal College of Science, Dublin, at the option of the holder, with maintenance and traveling allowances.

A free studentship entitles the holder to free admission to the lectures and laboratories and to instruction during the course for the associateship—about three years—in the Royal College of Science, London, but not to any maintenance or traveling allowance.

Besides the above students who have been successful in the examinations of the science classes, a limited number (usually about sixty) of teachers, and of students in science classes who intend to become science teachers, are admitted free for a term or session to the courses of instruction. They may be called upon to pass an entrance examination. Of these, there are two categories—those who come to learn and those who remain to teach; some of the latter may be associates.

Besides all these, those holding Whitworth scholarships—the award of which is decided by the science examinations—can, and some do, spend the year covered by the exhibition at the college.

In this way, then, is the *École Normale* side of our institution built up.

The number of Government students in the college in 1872 was 25; in 1886 it was 113; and in 1897 it was 186.

The total number of students who passed through the college from 1882–'83 to 1896–'97, inclusive, was 4,145. Of these, 1,966 were Government students. The number who obtained the associateship of the Royal School of Mines from 1851 to 1881 was 198, of whom 39 were Government students, and of the Royal College of

Science and Royal School of Mines from 1882 to 1897 the number was 525, of whom 323 were Government students. Of this total of 362 Government students 94 were science teachers in training.

With regard to the Whitworth scholarships, which, like the exhibitions, depend upon success at the yearly examinations throughout the country, I may state that six have held their scholarships at the college for at least a part of the scholarship period, and three others were already associates.

So much for the prizemen we have with us. I next come to the teachers in training who come to us. The number of teachers in training who have passed through the college from 1872 to 1897, inclusive, is about six hundred; on an average they attended about two years each. The number in the session 1872–'73, when they were first admitted, was sixteen, the number in 1885–'86 was fifty, and in 1896–'97 sixty. These have not as a rule taught science classes previously, but before admission they give an undertaking that they intend to teach. In the earlier years some did not carry out this undertaking, doubtless because of the small demand for teachers of science at that time. But we have changed all that. With but very few exceptions, all the teachers so trained now at once begin teaching, and not necessarily in classes under the department. It is worthy of note, too, that many royal exhibitioners and national scholars, although under no obligation to do so, also take up science teaching. It is probable that of all the Government students now who pass out of the college each year not less than three fourths become teachers. The total number of teachers of science engaged in classes under the department alone at the present time is about six thousand.

I have not yet exhausted what our college does for the national efforts in aiding the teaching of science.

When you, gentlemen, leave us about the end of June for your well-earned holidays, a new task falls upon your professors in the shape of summer courses to teachers of science classes brought up by the department from all parts of the four kingdoms to profit by the wealth of apparatus in the college and museum, and the practical work which it alone renders possible.

The number of science teachers who have thus attended the summer courses reaches 6,200, but as many of these have attended more than one course, the number of separate persons is not so large.

Research.—From time to time balances arise in the scholarship fund owing to some of the national scholarships or royal exhibitions being vacated before the full time for which they are tenable has expired. Scholarships are formed from these balances and awarded among those students who, having completed the full course of training for the associateship, desire to study for another year at the college. *It is understood that the fourth year is to be employed in research in the subject of the associateship.*

The gaining of one of the Remanet scholarships, not more than two on the average annually, referred to, furnishes really the only means by which deserving students are enabled to pursue research in the college; as, although a professor has the power to nominate a student to a free place in his laboratory, very few of the most deserving students are able to avail themselves of the privilege owing to want of means.

The department only very rarely sends students up as teachers in training for research work, but only those who intend making teaching their profession are eligible for these studentships.

I trust that at some future day, when we get our new buildings—it is impossible to do more than we do till we get them—more facilities for research may be provided, and even an extension of time allowed for it if necessary. I see no reason why some of the 1851 exhibition scholarships should not be awarded to students of this college, but to be eligible they must have published a research. Research should naturally form part of the work of the teachers in training who are not brought up here merely to effect an economy in the teaching staff.

Such, then, in brief, are some of our normal-school attributes. I think any one who knows the facts must acknowledge that the organization has justified itself not only by what it has done, but also by the outside activities it has set in motion. It is true that with regard to the system of examining school candidates by means of papers sent down from London, the department was anticipated by the College of Preceptors in 1853, and by Oxford and Cambridge in 1858; but the action of 1861, when science classes open to everybody, was copied by Oxford and Cambridge in 1869. The department's teachers got to work in 1860, but the so-called "University Extension Movement" dates only from 1873, and only quite recently have summer courses been started at Oxford and Cambridge.

The chemical and physical laboratories, small though they were in the department's schools, were in operation long before any practical work in these subjects was done either at Oxford or Cambridge. When the college laboratories began, about 1853, they existed practically alone. From one point of view we should rejoice that they are now third rate. I think it would be wrong of me not to call your attention to the tenacity, the foresight, the skill, the unswerving patience, exhibited by those upon whom has fallen the duty of sailing the good ship "Scientific Instruction," launched, as I have stated, out upon a sea which was certain, from the history I have brought before you, to be full of opposing currents.

I have had a statement prepared showing what the most distinguished of our old students and of those who have succeeded in the department's examinations are now doing. The statement shows that those who have been responsible for our share in the progress of scientific instruction have no cause to be ashamed.

Conclusion.—I have referred previously to the questions of secondary education and of a true London University, soon, let us hope, to be realized.

Our college will be the first institution to gain from a proper system of secondary education, for the reason that scientific studies gain enormously by the results of literary culture, without which we can neither learn so thoroughly nor teach so effectively as one could wish.

To keep a proper mind-balance, engaged as we are here continuously in scientific thought, literature is essential, as essential as bodily exercise, and if I may be permitted to give you a little advice, I should say organize your athletics as students of the college, and organize your literature as individuals. I do not think you will gain so much by studying scientific books when away from here as you will by reading English and foreign classics, including a large number of works of imagination; and study French and German also in your holidays by taking short trips abroad.

With regard to the university. If it be properly organized, in the light of the latest German experience, with complete science and technical faculties of the highest order, it should certainly insist upon annexing the School of Mines portion of our institution; the past history of the school is so creditable that the new university for its own sake should insist upon such a course. It would be absurd, in the case of a nation which depends so much on mining and metallurgy, if these subjects were not taught in the chief national university, as the University of London must become.

But the London University, like the Paris University, if the little history of science teaching I have given you is of any value, must leave our normal college alone, at all events till we have more than trebled our present supply of science teachers.

But while it would be madness to abolish such an institution as our normal school, and undesirable if not impossible to graft it on the new university, our school, like its elder sister in Paris, should be enabled to gain by each increase in the teaching power of the university. The students on the scientific side of the Paris school, in spite of the fact that their studies and researches are looked after by fourteen professors entitled Maîtres de Conférences, attend certain of the courses at the Sorbonne and the Collége de France, and this is one of the reasons why many of the men and researches which have enriched French science hail from the *École Normale.*

One word more. As I have pointed out, the French *École Normale* was the result of a revolution; I may now add that France since Sedan has been doing, and in a tremendous fashion, what, as I have told you, Prussia did after Jena. Let us not wait for disastrous defeats, either on the field of battle or of industry, to develop to the utmost our scientific establishments and so take our proper and complete place among the nations.—*Nature.*

THE SERIES METHOD: A COMPARISON.

By CHARLOTTE TAYLOR.

BROADLY speaking, there are two methods which are used for the teaching of a language: that of the mother and that of the grammarian. The child learns its own or *mother* tongue from the mother; it learns a foreign tongue from a teacher, whose highest ambition is to be a grammarian. Does the child learn better from the mother or from the grammarian? Without doubt, from the mother, according to the mother method. If this is so, must we use the example of the mother or of the grammarian when we are to begin the teaching of a foreign language? Is there any reason why a foreign tongue should be otherwise taught than the mother tongue? Is it not at least worth the trouble to try the method of the mother, when it is every day demonstrated that pupils who have had five, six, seven years of teaching are unable, on leaving school, so much as to understand when the language they have been studying is used in conversation?

Let us attempt to obtain light on the differences between these two principal methods that exist for teaching a language. What is the mother's method? How does she teach the child to speak? First let us notice that the mother follows the child: she allows him first to show interest in something and then helps him to express *himself.* Here we must pause to notice that what most interests the child is not a thing, an object for itself, but the capacity of the thing to do something, the possibilities of the thing for the performance of an action. A young child takes a thing in its hand and waves it, or strikes it against something, or passes it from one hand to the other; when it is older, it asks invariably, "What for?" The mother names the thing to the child, and also the action that may be therewith performed. The child begins to play. Here a specialty of the mother method comes into view. The mother tells the child that she is *pleased* or *displeased* with him, that it makes her *happy* or *unhappy* when the child does this or that, that she *thinks* he is a good or a naughty boy, etc.—all of which remarks express her feelings, her thoughts, in contradistinction to the actions which have occasioned these feelings and thoughts; the realm of the mind as opposed to the world of activity. Let us here notice that the speech of every people contains these two classifications of words, the objective and the subjective; and indeed it must be so, since we perform actions and we judge of our actions. By this method the child learns in about a year from the time it begins to speak to express itself about what it does and what it thinks.

Now what is the method of the grammarian? The child learns first the names of things that do not appeal to his consciousness, for they do not start from his point of view, but from that of the maker of a book. He learns lists of words—that is, he learns to know the *symbol*, and not the *thing;* he translates. He learns about Cæsar's wars and the book of his father's uncle in what is called an exercise. For both of these subjects he feels no interest, which is to be expected, as they are abstract. He sees no action. Of the great part of language, which may be called the speech of feeling, he also learns only in the abstract. He reads that Cæsar was glad or that his father's uncle was angry, but the happiness and the anger are outside of his consciousness; they have been presented to him by symbols, that is, printed words. By this method the child learns in about four years to read fairly well; as a rule, speaking the language is entirely out of the question. The pupils can not talk of their actions and their feelings, because these are represented to them by symbols, for such are printed words; they have not grasped them as actualities. If on going into a foreign country they are able to understand what is being said, the teacher may consider himself lucky. He has done his utmost with the method he has chosen to employ. He has attained something. It remains true that the mother accomplishes more in a shorter time than the grammarian.

But is it perhaps possible to put the two methods together, and thus to create a method which shall contain the good of both? We must not continue always to act as the mother does, to teach after her method, or our pupils will continue to talk like a child of two years, and be furthermore unable to write at all. How shall we manage to melt the two into one compact, inseparable whole?

Let us imagine a class is to take its first lesson in the foreign tongue. First, what shall be the matter of the lesson; then, how shall it be presented? We shall be careful to choose a subject that can be interesting to the pupil, hence a subject containing activity.

It is not necessary that it should be anything astonishing or unusual. Let us consider with the pupils how one opens the class-room door. Let us ask the pupil in his mother tongue how he does it, carefully drawing his attention to the number of actions necessary to the accomplishment of our aim, such as walking, standing still, extending the arm, grasping the knob, etc., together with the resulting actions on the part of the door, opening, swinging, etc. We will then draw his attention to the words of activity, the verbs, and tell him he is going to learn those words in the new language—say German. We will now take the first verb necessary to the accomplishment of our aim, that of walking. We will say, *while we walk*, such sentences as " This is gehe," " See how I gehe," " My feet move when I gehe," etc. We do the same with each verb, always with its accompanying action. We will take the first four verbs of our subject, repeat them the first time with many explanatory phrases, the second time with fewer, the third and last time we shall simply repeat the verbs " gehe," " stehe still," " strecke aus," " fasse an," always with the actions. By this time the pupils will know these, they having heard each one at least seven times. We can now allow them to recite, we still giving the clew by the production of the appropriate action. Having taught these first four verbs, we are now ready for the full sentence "I walk toward the door," " I stand still by the door," " I reach out my arm," " I take hold of the knob." We can teach the subject " ich " without difficulty, as it remains the same in all the sentences. Let us take the nouns and teach in this manner: " Ich gehe "—pointing—" Thür," then a repetition of " Thür " contained in sentences describing it, with at least three repetitions of the word. Then come the words showing direction and relation. If you say " Ich gehe "—pointing—" Thür," the pupil will know that there is a word lacking, and he will be unsatisfied till he knows it. We now have a sentence, " Ich gehe nach der Thür." We will teach the other sentences in the same way; we will repeat each sentence at least three times in its entirety, and we will allow the pupils to recite. Here it is of interest to show the pupil that the sentence has sprung from the verb, that the verb is the germ of the sentence. Whether we do this with the words " verb," " sentence," " germ," must depend on the capacity of the class. It is not a question of words, but of ideas. Let us present our subject as a living thing. To supply the pupil with an old-fashioned grammar exercise is like inviting him to make a dinner off papier-maché joints and steaks.

All this time we have been considering the part of language which deals with the *outside* world. It is now time to consider how we shall present the part of language which deals with the inner life. We must make the pupil capable of expressing his states of mind, his thoughts, because these thoughts are interesting to him. There is, broadly speaking, only one situation in class about which his mind is working: his own success or failure to recite. Hence, before each recitation we shall speak a sentence of encouragement or command, such as "Please begin," "I think you are going to do well." After each recitation we shall speak a sentence of praise or blame, such as "Very good," "It might have been better." These, as they can not be expressed by actions, may be translated when necessary into equivalent phrases in the mother tongue. We shall illustrate each phrase by stories, riddles, quotations, whatever you like. The pupil will be interested, and hence will remember. It is not necessary to the acquisition of knowledge that the pupil should be thoroughly bored while trying to learn. After a sufficient number of repetitions of a phrase by the teacher, it will be handed over to the pupils, who will then address to each other phrases of encouragement, command, praise, blame, etc. We have now enabled the pupil to express an action and his thought; the outside and the inside world are his; he needs only to advance as he began. Each lesson proceeds in this wise:

EXAMPLE.

Part I.—Teacher: "We shall learn about opening the door." General subjective phrase, "Pay attention." Explanation of the phrase through stories.

Teaching of *verbs*.

First subjective phrase before recitation, "Please begin." Explanation through stories.

Recitation.

First subjective phrase after recitation, "Very good." Explanations through stories.

After the teaching of the *sentences*, the subjective phrases are spoken by the pupils.

It lies in the intelligence of the teacher to recognize the moment for introducing phrases.

The lesson then proceeds to the movements of the door as Part II, and to our leaving the door as Part III. The scheme is the same.

All this is a copy (systematized, of course) of the method employed by the mother. Now, first, can the grammarian be useful to us? Let us remember that to begin with his method is to put the cart before the horse. He must play the second but also an important part. The child learns to speak first, but he also learns to read and to write. We will give the same lesson to the pupil in printed form; he will be asked to read it, and then to copy it or write it from dictation. He will receive the new speech through the sense of hearing; it will then be communicated to the sight, and then to the touch. In this manner a class of twenty girls of about thirteen years had been taught English. After about thirty printed lessons had been mastered with the anecdotes, riddles, etc., which had occupied about half a German school year, they were not only able to read and write without many mistakes, but showed a strong desire to express themselves in the new tongue, and were, indeed, able to do so very satisfactorily, as compared with the results obtained by the grammarian after a seven years' course.

Who first thought of combining the two original methods of language teaching in this way? A Frenchman, named François Gouin. He gave it the name of the "Series Method," because each lesson contains a series of actions. After the pupil has learned to express himself in regard to his immediate surroundings he continues to learn in series in regard to the lives of animals and of plants, the processes of housekeeping, traveling, trade, etc. It is all presented simply, but each has its own appropriate words and expressions. As soon as the pupil has mastered the rudiments he will also have the subjective matter presented in a series; in one lesson the teacher will be inclined to mirth, in another to (mock) anger, in another to hope, in another to (mock) despair.

The most important result of education being the evolution of the character already present in the child, let us not consider him a little empty jug to be filled with knowledge; rather let us seek to draw out the riches of his character. When he is able to *live* in a new language, he will be ever broadened, refreshed, and renewed.

This method, resting on a psychological basis, is, with modifications of manner, which it remains the duty of the teacher to recognize, just as good for an adult as for a child. Rules of grammar will be earlier given to the adult, because he will notice correspondences and differences sooner than the child. But no rule will ever be given to a pupil of any age till he himself can appreciate its value, till he is mentally beginning to ask "why?" This questioning state of mind is one highly to be desired, as it is a state of receptivity.

THE highest point yet reached by a kite was attained by the leader of a tandem sent up from the Blue Hill Observatory by Messrs. Clayton and Ferguson, August 26th, 12,124 feet above the sea, 277 feet higher than had previously been reached by any kite. The five miles of line weighed seventy-five pounds, and the weight of the whole was one hundred and twelve pounds. With a temperature of 75° and wind velocity thirty-two miles an hour on the ground, the temperature was 38° and the wind velocity thirty-two miles an hour at the highest point reached, while the highest wind velocity recorded was forty miles an hour at 11,000 feet.

THE EARLIEST WRITING IN FRANCE.

By M. GABRIEL DE MORTILLET.

THE ancient Celts and Gauls of France had no real letters. A few Celtiberian pieces of money bear characters belonging to the Phœnician and Carthaginian alphabets. In Cisalpine Gaul we find Gallic written in ancient Italian characters. The Greeks, when they founded Massilia and spread themselves along the Mediterranean coast of France, brought their language and writing into the country. The Gauls took advantage of this, and many Gallic inscriptions in Greek characters occur scattered through the south of France, among much more numerous inscriptions in the Greek language and character.

When the Romans came, the Latin alphabet rapidly took the place of the Greek, and the few Gauls that continued faithful to the old tongue used Latin characters in engraving the inscriptions they have left us. Similar changes took place in Gallic pieces of money. Excepting the Celtiberian coins with their Semitic legends and characters, which are found only in a very limited district in the southwest of France, Gallic coins, when they have characters upon them, may be classified as those with Greek and those with Latin legends. The former are very abundant in the south of France, and extend, growing more rare, as we go on into the center and north. Gallic coins with legends in Roman characters gradually become more numerous, and were general after the conquest of Gaul by Julius Cæsar, some of the Gallic populations having only begun to coin money during the earlier period of the Roman occupation.

There are some evidences of the use of a symbolical and hieroglyphical writing before alphabetical writing. On some of the megalithic monuments, principally in Morbihan, stones are found bearing incised engravings, and sometimes sculptures in relief. Are the engravings simply ornamental motives, have they a symbolical meaning, or are they hieroglyphic emblems? Opinions are divided.

The supports of the large and handsome dolmen of the little island of Gavrinis, Morbihan, are filled with engraved lines running into one another and conforming to the shape of the stone or to its composition—all the siliceous and consequently very hard parts being free from them. This indicates a simple ornamentation or decoration executed without any special plan made in advance, according to the nature and form of the stone worked upon. Yet, among the lines of the apparently fanciful ornament a number of polished stone hatchets are very distinctly represented. In all the other dolmens the carvings are much less numerous and not so close. Sometimes they are distributed around, and sometimes they are isolated. Among them we remark the frequent repetition of some forms in groups or singly, which suggest the thought of signs with a determined sense. Upon a large support of the dolmen of the Petit-Mont at Arzan (Morbihan) there are at the lower left hand three crosses, a sign of frequent occurrence on the megalithic carvings. Above these are two very wide open U's. Seidler sees in these signs letters of the Libyan alphabet, the cross corresponding to C, and the other sign to M. Some persons have further thought they could distinguish an Egyptian letter in the cross. Taking a more general view of the question, Letourneau * has tried to prove that the sculptures on the megaliths are inscriptions, and the engraved signs correspond to letters of the ancient alphabets, most probably Semitic. Adrien de Mortillet answered that the thought of writing involved arrangement, and no arrangement could be predicated of the signs.

A short time afterward, Adrien de Mortillet, in a paper on the Figures sculptured on the Megalithic Monuments of France, proved that the figures are more or less rude designs representing a well-determined series of objects. Thus the U's, with branches very widely separated, represent boats, and are emblems of migrations by sea; the crosses are shipmasters' staffs, or insignia of chiefs similar in character to bishops' crosses. The polished hatchet is frequently figured, and often with a handle, and is the emblem of labor, or, more probably, of combat. The scutcheons, which are also frequent, are bucklers, or military symbols. They are usually adorned on the inner side with a variety of symbolical figures variously grouped, which evidently served as the owner's coat of arms, and are the most ancient known specimens of the kind, going back to the stone age, or at least to the transition age from stone to bronze. After that time the custom of putting their owners' arms upon bucklers spread widely. It lasted till the end of the middle ages. The painted vases of classical antiquity furnish numerous and very curious examples of such marks. The interpretation of the megalithic sculptures may furnish probable if not certain details concerning an epoch which is very little known to us. Thus, the scutcheon of the dolmen *des Marchands*, containing four series of crosses, one above the other, and each series divided into two parts, fifty-six crosses in all, may have been the arms of a chief of a powerful confederation having fifty-six less important chiefs under his orders. The supposition is confirmed by the dimensions of the monument and a large handled hatchet engraved under the tablet between two other crosses.

Near the dolmen *des Marchands*, and not far from the sea, is

* Ch. Letourneau. Alphabet Forms in Megalithic Inscriptions. Bulletin of the Society of Anthropology, 1893.

the large tumulus of Marie-Hroeck, which includes a small dolmen containing rich funerary furnishings. In front of the entrance to the cavern is a rectangular slab that bears on its face a scutcheon containing two crosses, symbolical of power, and several very rudely drawn representations of boats. The engravers of this period were not artists, but stone-cutters, working upon a very hard rock with very poor tools. Unable to figure distinctly what they wanted to, they did the best they could. Handled hatchets were distributed irregularly all round the scutcheons. Does not this epitaph seem to mean that the tomb was erected in memory of a powerful maritime chief by soldiers, his companions in arms?

From these bucklers we pass to generalized feminine representations characterized by concentric necklaces and pairs of prominent globular breasts. Such sculptures, which are repeated in various dolmens and artificial mortuary caves in the valley of the Seine, may be of religious import. They seem to be replaced in the south of France by attempts at statues. Of such character are the two sculptures of the dolmen of Collorgues in Gard, which also have the symbolical cross on their breasts.

Whatever they may be, the megalithic engravings are the earliest graphic historical documents of the country. It is therefore important to collect and preserve them.

They may be divided into simple ornamental motives, which may further suggest interesting resemblances; figurative engravings representing known and definite objects and forming commemorative pictures capable of affording important historical or legendary hints—the most ancient documents in our archives; and symbolical engravings of more difficult determination, and independent of any alphabet.

Among the specimens of the last class, one sort, the cupule, is extremely widespread. It is a very regularly shaped hemispherical cup, generally represented by itself, but sometimes mingled with other figures, most usually occurring in groups without arrangement, but very rarely isolated. Entire surfaces are sometimes covered with this design. It is a very ancient design, as such cupules are found on the dolmens. In the dolmen of Kériaval, at Locmariquer, the lower side of the horizontal slab is starred with numerous cupules, which antedate the construction of the monument, for they appear on the parts that rest on the supports. There may also, however, be more recent cupules. We are totally in the dark as to what they represent.

Cupules are sometimes cut on the surface of rocks in place. Engravings similarly cut have been designated sculptures on rocks, and are found almost everywhere. Those which have been most studied and afford the most features of interest for us are on the Scandinavian coasts, and these have been largely utilized by Adrien de Mortillet for the determination of the figures of megaliths. We cite only one example from Gaul, the sculptures in the rocks of the Lago dei Maraviglie, in a lateral valley on the left, going from San Dalmazo to Tende, in Piedmont. Some of the walls of the rock there and large surfaces of detached blocks are covered with extremely rude figures formed by the accumulation of dints resulting from frequently repeated blows. Among these figures, which are without order in the grouping, and in which no regard is paid to proportions, are stags, rams, human figurines, hatchets, pikes, baskets, and lance points. These sculptures have been ascribed to the neolithic or the bronze age; but the existence of figures of similar style on the walls of a lead mine near Valauri has suggested that they may be more recent. Human figurines are numerous, but heads of horned animals are more so. Some are perhaps stags and rams, while bulls and cows are abundant. The shepherds are accustomed to take their herds and keep them for two or three months every year in this valley, which is so lonely and melancholy in aspect that it has been called Vallée d'Enfer, or Hell Valley. It would not be strange if these herdsmen, for want of something better to do, should have amused themselves delineating the things that were before their eyes—the cattle, the miners, and things appertaining to the mine. As to special traits, the representations are so badly executed as to leave a wide range open for interpretation.—*Translated for the Popular Science Monthly from the Book Formation de la Nation française* (Paris: Félix Alcan).

An old Newcomen steam engine at North Ashton, near Bristol, England, as described by Mr. W. H. Pearson in the British Association, is still doing practical work after an active career of nearly one hundred and fifty years, it having been erected in 1750 at a cost of seventy pounds. The piston is packed with rope, and has a covering of water on the top to make it steam tight. The working of the engine is aided by the vacuum formed by the injection of water into the cylinder. The old man now engaged in working this engine has held his post since he was a lad, and his father and grandfather occupied the same position.

The excavation of the Roman town of Calleva Attrebatum at Silchester, near Reading, England, has brought to light nearly forty complete houses, a private bathing establishment, two square temples, the west gate, a Christian church possibly of the fourth century, a basilica and forum, an extensive system of dye works, a series of drains, other works, and a multitude of ornaments and utensils—remains of Roman civic life and institutions, complementing previous discoveries of Roman monuments in England, which have been mostly military.

SKETCH OF GABRIEL DE MORTILLET.

"THE Ecole d'Anthropologie feels with a profound emotion the loss of the eminent master, one of its glories, whose labors have contributed in so large a measure to honor and magnify it, and to extend and confirm its legitimate authority, and who had the exceedingly rare merit of constituting a science which by means of him has become a French science—that of prehistoric archæology." Such is the eminently fitting tribute spoken by the professors of the Paris École d'Anthropologie through their *Revue Mensuelle* to the memory of Gabriel de Mortillet.

Louis Laurent Gabriel de Mortillet was born at Meylan, Isère, France, August 29, 1821, and died September 25, 1898. He began his studies with the Jesuits at Chambéry, and continued them in Paris at the Museum of Natural History and at the Conservatoire des Arts et Métiers. He was interested in the revolutionary movements of 1848; and in the insurrectionary demonstration of the 13th of June, 1849, which followed the presentation by Ledru Rollin, on the 11th, of a resolution of impeachment against President Louis Napoleon for repressing the republican movement in Rome, it was with his help that the eminent deputy was enabled to escape arrest. In the same year he was condemned for a press offense and took refuge in Savoy. During his exile he classified the collections of the Natural History Museum in Geneva; had charge of the arrangement of the Museum at Annecy in 1854; directed an exploitation of hydraulic lime in Italy; and served as geological adviser in the construction of the northern railways of that country. He was also associated with Agassiz in his studies of the glaciers of Switzerland. He returned to Paris in 1864, and in 1867 was charged with the organization of the first hall or prehistoric department of the History of Labor at the Universal Exposition of 1867. In 1868 he was called to the Museum of National Antiquities at Saint-Germain-en-Laye, where he continued till 1885. It is specially mentioned that he carried this institution safely through the perils of the war of 1870–'71. While engaged in these museum tasks he was struck with the insufficiency of the then universally accepted paleontological and prehistoric classifications, and his attention became fully absorbed in the subject. He held long consultations with Edouard Lartet, the eminent paleontologist and his learned friends concerning it. As a result of these deliberations, after careful study of the formations and specimens, he proposed a scheme of classification in 1869, which was completed at the congress held in Brussels in 1872, and has become generally accepted in its fundamentals, after having withstood the often-repeated attacks of persistent criticism, and has received confirmation after confirmation from innumerable discoveries made throughout the world. "Had his activity concerned only the classification of the different stone ages," says Dr. Capitan, whose eulogy of M. de Mortillet we follow most largely in our sketch, "de Mortillet would for that work alone have been by good right considered a great man of science. Actually to illuminate a number of dark points, to group a thousand scattered facts in regular order, to synthetize numerous isolated researches, to constitute a cohesive theory of them—that is what de Mortillet did. Thus he became long ago the uncontested master, the leader of a school, who was able to group and hold around him the scientific students and workers of the entire world."

M. de Mortillet was in 1866 one of the founders of the International Congress of Prehistoric Archæology. He was one of the first professors in the École d'Anthropologie founded by Broca in 1875, the greatest achievement, as he writes in the preface to his *Formation de la Nation française*, of the Association for the Teaching of Anthropological Sciences. The school was opened in November, 1875, in a building gratuitously lent it by the École de Médecine, to give instruction free of tuition charges, and was to be maintained by a fund subscribed by anthropological societies and private persons, a gift of fifteen hundred dollars a year by M. Wallon for laboratory purposes, and a grant of twenty-five hundred dollars from the Municipal Council of Paris for the payment of professors' salaries. Five courses of lectures were to be delivered, to be increased as the resources of the association multiplied. The association and the school were recognized as of public utility by a law of 1889; the school being the first establishment of private instruction, Dr. Capitan said in his memorial address, "and up to this time (1897) the only one that has had that honor, an honor that creates duties for us. We are under obligation to clarify and extend our teaching." De Mortillet's work was so true to the sentiment expressed in this sentence that one of the characteristics attributed to him in the short biography published in Vaporeau's *Dictionnaire Universel des Contemporains* is that he was one of the men who contributed most to the popularizing of prehistoric studies in France. During the more than twenty years of his professorship of prehistoric anthropology in the École, de Mortillet "gave precious instruction to numerous students, many of whom, foreigners, have in their turns become masters in their own countries." He was also president of the Society of Anthropology, subdirector of the École d'Anthropologie, president of the Association for Teaching Anthropological Sciences, and president of the Commission on Megalithic Monuments—the various functions of which offices he filled with remarkable exactness and distinction.

"In all these important positions," says Dr. Capitan in his eulogy, "de Mortillet unfailingly brought a uniform ardor to his work, a uniform activity, a clear and acute wit, and a remarkable precision. He performed his numerous duties almost to the end of his life. Only last month (July, 1898) he made another journey for the execution of a mission which the commission on megalithic monuments had intrusted to him."

In connection with these multifarious labors, M. de Mortillet published a considerable number of memoirs and of books of the highest order. He was a transformist from the very first, and performed all his various researches in the spirit of an evolutionist. His first publications were on conchology, and numerous memoirs between 1851 and 1862 related to subjects in that branch. During the same period he contributed many important works on the geology and mineralogy of Savoy. Among these were the History of the Land and Fresh-water Mollusks of Savoy and the Basin of Lake Leman, and a Guide to the Traveler in Savoy. His attention was afterward more entirely directed to prehistoric archæology and anthropology, and he published in 1866 a curious Study on the Sign of the Cross previous to Christianity. Of this period, too, are his Promenades, or Walks, in the Universal Exposition of 1867, and his Walks in the Museum of Saint-Germain, 1869. He founded, in 1864, the Recueil, or Collection of Materials for the Positive History of Man, which was afterward continued at Toulouse by M. E. Cartailhac. In 1879 he published a work on pottery marks—*Potiérs allobroges, ou les Sigles figulins étudiés par les Méthodes de l'Histoire naturelle.* In 1881, in co-operation with his son, Adrien de Mortillet, as artist, he published a magnificent illustrated work or album, *Le Musée Préhistorique* (The Prehistoric Museum); and in 1883, the volume *Le Préhistorique* (Prehistoric Archæology); two books which have taken rank as master works. A second edition of the *Préhistorique* appeared in 1885, and at the time of his death he was preparing a third, in which he was taking great pains to bring the matter up to the present condition of the science. Another important work was the *Origines de la Chasse et de la Pêche* (Origin of Hunting and Fishing). A considerable number of memoirs by M. de Mortillet appeared in various scientific journals, especially in the two founded by him—*Les Matériaux pour l'Histoire primitive et naturelle de l'Homme,* already mentioned, and *L'Homme,* which was established in 1884.

An epoch in M. de Mortillet's life was marked in 1873, when a discussion took place at the Anthropological Congress, in Lyons, between him and M. Abel Hovelacque concerning the precursors of man. The researches of the two masters had already led them, by a series of observations and deductions, to regard as certain the geological existence of a being intermediate between man and the monkey, which they called the *Anthropopithecus*, and they were trying to indicate, hypothetically, its leading characteristics.

M. de Mortillet's reasons for believing in the existence of this precursor of man as a definite being were presented in the *Revue d'Anthropologie*, in an article which was translated and published in the Popular Science Monthly for April, 1879. In this paper the author summarized the evidence, already copious, in favor of the existence of Quaternary man, and then took up the question, "Did there exist in the Tertiary age beings sufficiently intelligent to perform a part of the acts which are characteristic of man?" He then reviewed the researches of the Abbé Bourgeois at Thenay in the light of a collection of fire-marked flints which he had exhibited at the International Congress of Prehistoric Archæology and Anthropology held in Paris in 1867, and deduced from the result that "during the Middle Tertiary there existed a creature, precursor of man, an anthropopithecus, which was acquainted with fire, and could make use of it for splitting flints. It also was able to trim the flint flakes thus produced, and to convert them into tools. This curious and interesting discovery for a long time stood alone, and arguments were even drawn from its isolated position to favor the rejection of it. Fortunately, another French observer, M. J. B. Rames, has found in the vicinity of Aurillac (Cantal), in the strata of the upper part of the Middle Tertiary—here, too, in company with mastodons and dinotheriums, though of more recent species than those of Thenay—flints which also have been redressed intentionally. In this case, however, the flints are no longer split by fire, but by tapping. It is something more than a continuation, it is a development. Among the few specimens exhibited by M. Rames, whose discoveries are quite recent, is one which, had it been found on the surface of the ground, would never have been called in question." The evidence afforded by these flints was confirmed by a collection of flints from the Miocene and the Pliocene of the valley of the Tagus shown by Señor Ribeiro in the same exhibition, a considerable proportion of which bore evidence of intentional chipping.

Bearing upon this point was a chart of the Palæolithic Age in Gaul, drawn up by M. de Mortillet in 1871, and published in the *Bulletin de la Société d'Anthropologie de Paris*—"the only work of the kind extant"—in which were recorded five localities in which occurred supposed traces of man in the Tertiary, forty-one alluvial deposits in the Quaternary yielding human bones and industrial remains, and two hundred and seventy-eight caverns containing Quaternary fauna with traces of prehistoric man.

M. de Mortillet gave in another form his view of the sort of creature the hypothetical anthropopitheeus should be in a paper on Tertiary Man, read before the Anthropological Section of the French Association for the Advancement of Science in 1885, when he said the question was not to find whether man already existed in the Tertiary epoch as he exists at the present day. Animals varied from one geological epoch to another, and the higher the animals the greater was the variation. It was to be inferred, therefore, that man would vary more rapidly than the other mammals. The problem was to discover in the Tertiary period an ancestral form of man a predecessor of the man of historical times. There were, he affirmed, unquestionably in the Tertiary strata objects which implied the existence of an intelligent being—animals less intelligent than existing man, but much more intelligent than existing apes. While the skeleton of this ancestral form of man had not yet been discovered, he had made himself known to us in the clearest manner by his works. The general opinion of the meeting after hearing M. de Mortillet's paper is said to have been that there could be no longer any doubt of the existence of the supposed ancestral form of man in the Tertiary period.

The discovery in Java, announced by Dr. Dubois, in 1896, of fossil remains presenting structural characteristics between those of man and those of the monkey, to which the name *Pithecanthropus erectus* was given, were accepted with hardly a question by M. de Mortillet and his colleagues as confirming his views.

At a banquet given to M. de Mortillet, May 1, 1884, by a number of anthropologists, when his portrait was presented to him, the hall was decorated for the occasion with a life-size picture of an ancient Gaul, executed according to his latest researches. The man was represented as having no hair on his body; with very long arms and very powerful muscles; his feet capable of being used in climbing trees, but with toes not opposable; his jaw strongly prognathous, but not at all equal to that of an anthropoid ape; his breadth strongly compressed laterally and his abdomen prominent; the skin not negroid, but of our present color; and the expression of his face was about as intelligent as that of an Australian.

In his *Le Préhistorique* M. de Mortillet attempted to determine how far distant was the epoch when *Homo sapiens* first appeared on the earth, by estimating the rate of progression of blocks which were carried by former ice fields, as he had observed them in Switzerland with Agassiz. His conclusion was that more than two hundred thousand years had elapsed since that event.

In 1894 M. de Mortillet proposed in the Société d'Anthropologie an important reform in chronology. Pointing out the inconvenience of using several different eras, such as the Foundation of Rome, the Flight of Mohammed, and the Proclamation of the French Republic, he suggested that ten thousand years before the Christian era be adopted as a general starting point. This would include all Egyptian chronology as known at the present day, and would leave five thousand years at the disposal of future discoverers.

"A spirit always youthful, a man of progress," says Dr. Capitan in his eulogy, "our dear master kept himself fully in the current with all work relating to prehistoric archæology. He knew how to profit by whatever would contribute to perfect his own work. He therefore, on different occasions, modified his classification so as to keep it up to date, realizing that a classification is an admirable instrument of study, which ought to go through the same evolution as the science to which it is applied." This high quality of his mind appears clearly in his last book, published in 1897—*Formation de la Nation française* (Formation of the French Nation). This book comprised the substance of his lectures of the term 1889–'90. In publishing it he disavowed all intention of producing a new history of France. There were enough of these in all shapes and sizes, written in the most varied styles, with diverse tendencies, and from the most different points of view, and there were some most excellent works among them, particularly that of M. Henri Martin, which seemed to him to contain all the historical information known. But all these histories, even that of Henri Martin, although he had been president of the Anthropological Society of Paris, appeared to M. de Mortillet to be at fault in their starting point. They gave too much place in their beginnings to the legendary and the imaginary, and not enough to natural history and palæethnology. It was M. de Mortillet's purpose to follow an inverse method—to regard direct observation alone; and he would rest only on the impartial and precise discussion of texts and facts. "Texts, documents, and facts," he said, "become more and more rare as we go back in time. I shall collect and examine them with the greatest care in order to make our origins as clear as possible, and to enlarge the scale of our history. I shall appeal in succession to all the sciences of observation, and when I have recourse to the texts, I shall subject them to the closest criticism and the most complete analysis." The texts on which historians had so far relied did not go back far enough. They told of events three thousand or, including the Egyptian hieroglyphic texts, seven thousand years old, but what was this compared with the immense lapse of time during which man has lived, going back into the Quaternary epoch? On this vast period the texts furnish no information. They were, besides, inaccurate, tinged with fable and poetry, with local and personal prejudice and ignorance, even as to the times to which they relate after history is supposed to have come in. If we want light upon this unrecorded past, we must seek it by the aid of palæthnological data; and anthropology may be very advantageously united with palæthnology to furnish valuable instruction concerning the autochthonic race of France, its development, transformations, customs, and migrations, and the invasions it suffered in the most remote antiquity. "With the aid of these two sciences, both of wholly new origin, we are able to trace the earliest pages of the history of France." The book begins with a review of what the texts afford regarding the earlier peoples of France; then brings forward the evidence yielded by language and the study of the evolution of writing; next presents the results of research respecting the precursors of man, the rise and development of industries, societies, and civilization; and studies the primitive races of perhaps two hundred and thirty thousand or two hundred and forty thousand years ago; their mixture with the other races that came in from abroad and possessed the country; and, finally, the formation of the French population as we now find it.

M. de Mortillet's relations with his pupils and with his country, and his private character, are spoken of in the highest terms. For more than twenty years his lectures at the École d'Anthropologie, treating the most various questions respecting prehistoric times, attracted large and attentive audiences, often including students from abroad, who afterward became masters of the science in their own countries. "He was always ready to receive workers in the science, even the least and humblest, to bestow advice and encouragement upon them, and to give them the benefit of his experience and extensive erudition, and for this his pupils and friends lament him." Against his integrity no suspicion was ever breathed.

In political faith he was always advanced, and ever true to his convictions. He was *maire* of Saint-Germain from 1882 to 1888, and deputy from the department of Seine-et-Oise from 1885 to 1889.

In the observations of the meteoric shower of November 13, 1897, at Harvard College Observatory, one of the meteors appeared, according to the calculations, at the height of 406 miles, and disappeared at the height of 43 miles, and at a distance of 196 miles. Another appeared at a height of 182 miles and disappeared at a height of 48 miles, and a distance of 74 miles. The first meteor was red or orange, or, to Prof. W. H. Pickering, the color of a sodium flame, and the other white. Both penetrated the atmosphere to about the same depth, and both were clearly Leonids. These facts go to show, Professor Pickering thinks, that the difference in color noted is not due to a mere grazing of our atmosphere in some cases, and a correspondingly low temperature, but to an actual difference in the chemical composition of the individual meteors.

Correspondence.

THE FOUNDATION OF SOCIOLOGY.

Editor Popular Science Monthly:

SIR: May I be permitted a word of comment upon your editorial entitled A Borrowed Foundation, published in the December number of the Popular Science Monthly? Whatever my readers and reviewers may have claimed for me, I myself have never claimed to be the discoverer of "the consciousness of kind." Not only Mr. Spencer, as he and you have shown; not only Hegel, as Professor Caldwell has shown; but also nearly every philosophical writer and psychologist from Plato and Aristotle down to the present time has more or less clearly recognized the phenomenon of "the consciousness of kind," although I do not know that any one but myself has called it by just this phrase. The only claim, then, that I put forward for my own work is that, in a somewhat systematic way, I have attempted to use the consciousness of kind as the postulate of sociology and to interpret more special social phenomena by means of it. In other words, I have used it as a "foundation"; and I am not aware that any other writer on sociology has ever done so. Mr. Spencer, I feel quite sure, makes no such claim for himself. The passage which he and you have quoted is taken from the Principles of Psychology; it is not repeated in the Principles of Sociology, where, if it had been regarded by Mr. Spencer as a "foundation," it should have been put forward as the major premise of social theory. Passing over the consciousness of kind, Mr. Spencer has chosen to build his system of sociology in part upon other psychological inductions, in part upon a biological analogy. The tables of the Descriptive Sociology are arranged in accordance with the organic conception, and nine and one half chapters of the Inductions of Sociology in the first volume of the Principles of Sociology are formulated in terms of it. Throughout the remaining parts of the Principles, however, sociological phenomena are explained in terms of two closely correlated generalizations that are psychological in character—namely, first, the generalization that "while the fear of the living becomes the root of the political control, the fear of the dead becomes the root of religious control"; and second, the generalization that militancy and industrialism produce opposite effects on mind and character, and, through them, on every form of social organization. The work that Mr. Spencer has done in elaborating these explanations is of inestimable value, but surely it is not an interpretation of society in terms of the consciousness of kind. Is it then quite fair to suggest that the use made of the consciousness of kind in my own work is a borrowed "foundation"?

However you and Mr. Spencer and my own readers may answer this question, I can sincerely subscribe to your affirmation that there is much more in Mr. Spencer's writings than most even of his truest admirers and most diligent readers have ever explored; and I should be sorry to be regarded as behind the foremost in appreciation of the great work which he has accomplished not only for philosophy in general, but especially for that branch of knowledge which has engaged my own interest. FRANKLIN H. GIDDINGS.

NEW YORK, *December 19, 1898.*

Professor Giddings, in his Principles of Sociology, spoke of the "consciousness of kind" as the "new datum which has been hitherto sought without success." Mr. Spencer, on the other hand, showed that this was not a new datum, inasmuch as he had formulated it himself in a work published many years previously. Professor Giddings says that the passage to which Mr. Spencer referred occurred in his Principles of Psychology, and not in his Principles of Sociology, where, "if it had been regarded by Mr. Spencer as a foundation, it should have been put forward as the major premise of social theory." But Professor Giddings surely does not forget that Mr. Spencer, in laying out his system of synthetic philosophy, made the whole of psychology the basis of, and immediate preparation for, sociology. Quite naturally a writer who is dealing with sociology separately, and not as part of a philosophical system, will find it necessary in laying his foundations to fall back on data furnished by the immediately underlying science; and this explains why Professor Giddings makes use in his Principles of Sociology of a datum which, whether drawn from Mr. Spencer's Psychology or not, was at least to be found there very distinctly expressed. Mr. Spencer himself says that he regarded it as a "primary datum," and calls attention to the fact that he devoted "a dozen pages to tracing the development of sympathy as a result of gregariousness." We are quite prepared to recognize the valuable use which Professor Giddings has made of the doctrine in question, and to admit that, by the extensive development he has given to it, he has imparted a special character and a special interest both to his Principles of Sociology and to his Elements of Sociology noticed elsewhere.—ED. P. S. M.

EVOLUTION AND EDUCATION AGAIN.

Editor Popular Science Monthly:

SIR: I have not before this acknowledged your reference to me in a spirited and instructive editorial that appeared in the December number of your excellent magazine, because an immediate reply might have been taken to indicate a desire, on my part, for a controversy, which I expressly disclaim; and besides, I have desired that the public might read and consider your views dispassionately. I care but little for the effect upon myself, if the cause of truth shall be materially strengthened.

I am not surprised that you refer to me as "ignorant," "negligible," etc., because it has for a long time been painfully clear that the "scientific mind" is exceedingly sensitive, and while much given to praising forbearance and kindness, still resorts to language reasonably regarded as abusive. I have always found this to be true, and the present controversy is no exception to the rule. The "broadly scientific mind" is, alas! too often narrow and intolerant in treating opposing views. I do not wish, however, to find fault with the abuse—it may prove to be good discipline, and is, therefore, thankfully accepted; but I do very much desire to correct a mistaken inference that you drew from my reference to Herbert Spencer. There are some typographical errors in the quotations that you make, which, however, do not change the meaning. Allow me then to say that I have a great regard for Mr. Spencer; that I have read his writings with much profit, and that I have never failed to accord him full credit for the work he has accomplished. That I can not understand and accept all his teachings does not lessen my respect for him.

At the time that I made my informal talk to the teachers of this city, I had no thought that my remarks would be published or would excite public criticism, or that I would be honored with so distinguished, so critical an audience, or I should have been more careful in the use of terms; but it does seem to me that there is no excuse for the distorted meaning that you and others have given to the quotations. I referred to Mr. Spencer's age to show that we could hope for no change in his philosophy, and the criticism that follows, if it may be styled a criticism at all, is that he has refused to recognize the Deity, and thereby fails to "bless, cheer, and comfort suffering humanity." You discuss it as if I had said that he had not *bettered* the condition of his fellows; but that idea is not in the statement that you quote at all The word "suffering" was intended to apply to those who, by reason of the misfortunes of this life, are compelled to look beyond themselves and their surroundings for comfort, and who in all ages and among all peoples have turned their thoughts toward a Divine Being for comfort. I merely intended to say, in a very mild and harmless way, that the consolations of a religion based upon a belief in a Divine Providence are necessary for *suffering* humanity, and my immediate reference to Cardinal Newman by way of contrast in almost the same language clearly shows this to be the true meaning of my remarks. The emphasis was on the word ' suffering," which was not intended to include more than a fraction of mankind.

I am obliged to you for your reference to Mr. Gladstone, who in his last illness illustrated most fully what I had in my mind. However great his pain, or cheerless the outlook, he continually with serene cheerfulness murmured, "I know that my Redeemer liveth," and "Our Father," etc. It is perhaps unnecessary to add that I am sorry that any one has been led to believe that I underrate the value of the life and work of Herbert Spencer.

Please allow me to refer to the statement in your editorial, "Again dealing with the modern scientific view, that in the development of the human individual all antecedent stages of human development are *in a manner* passed through," etc., in order that I may express my regret that you seem to vitiate the force of the statement altogether by the use of the unscientific phrase "in a manner." The tremendous consequences growing out of the view make serious and exact definition and treatment imperative, and I had hoped that I was entering upon a helpful discussion of it, but was greatly disappointed. I am also unwilling to believe that students of Emerson will be easily convinced that he looked at life "from a stationary point of view," but I do not feel that I can claim your valuable time for a discussion of this point.

May I trust your forbearance in pointing out a manifest misconception in your statement, "We are not imposed upon by childish imitations of mature virtues"? The remark indicates that you have not been brought into immediate association with school children in a schoolroom, at least in recent years.

I refer very reluctantly, but I trust without seeming egotism, to your remarks touching my election to the position which I hold. I am innocent of all responsibility in the matter. I had no "pull" (is the term scientific?). I wrote to the board declining to be a candidate. I refused to allow my friends to speak to the members of the board in my behalf; I preferred the position (Principal of the St. Paul High School) which I had held for years, and I accepted the office with much hesitation; but the intimation that our Board of School Inspectors, composed of business men in every way highly esteemed by the citizens of St. Paul, and deemed worthy of all confidence, had been actuated by unworthy motives, is entirely gratuitous and out of place in a journal such as you would have us believe yours to be. Could there be offered better evidence of haste and unfairness than this uncalled-for assault upon those of whom you know absolutely nothing, and does it not show the scientific inclination to have theory with or without facts, but certainly theory?

Yours very truly, A. J. Smith,
Superintendent of Schools.

St. Paul, Minn., *January 4, 1899.*

We took the report of Superintendent Smith's address which appeared in the St. Paul papers. If there were any "typographical errors" in our quotations, they were not of our making; and Mr. Smith admits that, such as they were, they did not affect the sense. Well, then, we found Mr. Smith using his position as Superintendent of Schools to disparage a man whom the scientific world holds in the highest honor, and for whom he now tells us he himself has "a great regard"—whose writings he has "read with much profit." We judged the speaker by his own words, and certainly drew an unfavorable inference as to his knowledge and mental breadth. If Mr. Smith did injustice to himself by speaking in an unguarded way, or by not fully expressing his meaning, that was not our fault; and we do not think we can properly be accused of having lapsed into abuse. The explanation he offers of his language regarding Mr. Spencer is wholly unsatisfactory. He gave his hearers to understand that there was an "old man" in London who had devoted all his energies to creating a system of thought which should entirely ignore the name of the Deity, and of whom, after his death, it would not be remembered that he had "ever performed an act or said a word that blessed or comforted or relieved his suffering fellows." The stress, he now says, should be laid on the word "suffering." He did not wish to imply that Mr. Spencer had not bettered the condition of his fellows generally; he only meant that he had done nothing for the *suffering*. On this we have two remarks to make: First, it is not usual, when a man is acknowledged to have given a long lifetime to useful work, to hold him up to reprobation because he is not known to have had a special mission to the "suffering"; and, second, that no man can be of service to mankind at large without being of benefit to the suffering. It is mainly because Mr. Spencer believes so strongly in the broad virtues of justice and humanity, has so unbounded a faith in the efficacy of what may be called a sound social hygiene, that he has had, comparatively, so little to say upon the topics which most interest those who apply themselves specifically, but not always wisely, to alleviating the miseries and distresses of humanity.

As to the means by which Mr. Smith obtained his present position, we know nothing beyond what he now tells us. We saw his appointment criticised as an unsuitable one in the St. Paul papers; and his published remarks seemed to justify the criticism. There are "pulls"—the word is "scientific" enough for our purpose—even in school matters; and it seemed that this was just such a case as a "pull" would most naturally explain. We quite accept, however, Superintendent Smith's statement as to the facts; and we sincerely trust that the next address he delivers to his teachers will better justify his appointment than did the one on which we felt it a duty to comment.

EMERSON AND EVOLUTION.

Editor Popular Science Monthly:

Sir: The editorial in the December Popular Science Monthly on the relations of Emerson to evolution must have surprised many of the students of Emerson. A little over two years ago Moncure D. Conway pointed out (Open Court, 1896) that soon after his resignation from the pulpit of the Unitarian Church with which he was last connected, Emerson taught zoölogy, botany, paleontology, and geology, and that he was a pronounced evolutionist who used in his lectures the argument in favor of evolution drawn from the practical identity of the extremities of the vertebrates. That Emerson was an evolutionist of the Goethean type is clear from most of his essays. In an essay appearing before the Origin of Species, he wrote as follows:

"The electric word pronounced by John Hunter a hundred years ago, *arrested and progressive development*, indicating the way upward from the invisible protoplasm to the highest organisms, gave the poetic key to Natural Science, of which the theories of Geoffroy Saint-Hilaire, of Oken, of Goethe, of Agassiz and Owen and Darwin in zoölogy and botany are the fruits—a hint whose power is not exhausted, showing unity and perfect order in physics.

"The hardest chemist, the severest analyzer, scornful of all but the driest fact, is forced to keep the poetic curve of Nature, and his results are like a myth of Theocritus. All multiplicity rushes to be resolved into unity. Anatomy, osteology, exhibit arrested or progressive ascent in each kind; the lower pointing to the higher forms, the higher to the highest, from the fluid in an elastic sac, from radiate, mollusk, articulate, vertebrate, up to man; as if the whole animal world were only a Hunterian museum to exhibit the genesis of mankind."

The Darwin to whom reference is made in this essay is not Charles, but his grandfather, one of the poets of evolution, Erasmus. The essay also shows the belief in evolution held by both Owen and Louis Agassiz before theological timidity made them unprogressive. The names quoted illustrate further the factors which influenced Emerson's thought in regard to evolution. Saint-Hilaire gave the *coup de grâce* to Cuvier's fight against evolution. Oken is one of the great pioneers of evolution. Goethe shares with Empedocles, Lucretius, and Erasmus Darwin the great honor of being a poet of evolution. Of the four, Goethe was by all odds the greatest. To him, the doctrine of evolution was of more importance than the downfall of a despot. The eve of the Revolution of 1830 found him watching over the dispute between Cuvier and Saint-Hilaire with an interest that obscured every other.

"'Well,' remarked Goethe to Soret" (Conversations with Eckermann) "'what do you think of this great event? The volcano has burst forth, all in flames, and there are no more negotiations behind closed doors.' 'A dreadful affair,' I answered, 'but what else could be expected under the circumstances, and with such a ministry, except that it would end in the expulsion of the present royal family?' 'We do not seem to understand each other, my dear friend,' replied Goethe. 'I am not speaking of those people at all; I am interested in something very different. I mean the dispute between Cuvier and Geoffroy de Saint-Hilaire, which has broken out in the Academy, and which is of such great importance to science.' This remark of Goethe's came upon me so unexpectedly that I did not know what to say, and my thoughts for some minutes seemed to have come to a complete standstill. 'The affair is of the utmost importance,' he continued, 'and you can not form any idea of what I felt on receiving the news of the meeting on the 19th. In Geoffroy de Saint-Hilaire we have now a mighty ally for a long time to come. But I see also how great the sympathy of the French scientific world must be in this affair, for, in spite of a terrible political excitement, the meeting on the 19th was attended by a full house. The best of it is, however, that the synthetic treatment of Nature introduced into France by Geoffroy Saint-Hilaire can now no longer be stopped. This matter has now become public through the discussion in the Academy carried on in the presence of a large audience; it can no longer be referred to secret committees or be settled or suppressed behind closed doors."'

It is obvious to any reader of Emerson's essays that Goethe exercised an enormous influence over him, and that Emerson was much more in sympathy with Goethe than was the fetichistic dualist Carlyle. This influence of Goethe over Emerson's views of evolution is clearly evident in the citation already made.

The evolutionary views of Emerson appear so frequently in his essays that it is astonishing that he should have been misunderstood. The citation by the Minneapolis clergyman from the essay on Nature that "man is fallen" does not refer to the Adamic fall, but the degenerating influence of cities. At the slightest glance, the evolutionary tendency of this essay on Nature is evident. In the paragraph immediately after that containing the reference to fallen man occurs the following:

"But taking timely warning and leaving many things unsaid on this topic, let us not longer omit our homage to the efficient Nature, *natura naturans*, the quick cause before which all forms flee as the driven snows, itself secret, its works driven before it in flocks and multitudes (as the ancient represented Nature by Proteus, a shepherd), and in indescribable variety. It published itself in creatures reaching from particles and spicula through transformation on transformation to the highest symmetries, arriving at consummate results without a shock or a leap. A little heat, that is a little motion, is all that differences the bald dazzling white and deadly cold poles of the earth from the prolific tropical climates. All changes pass without violence by reason of the two cardinal conditions of boundless space and boundless time. Geology has initiated us into the secularity of Nature and taught us to disuse our school-dame measure and exchange our Mosaic and Ptolemaic scheme for her large style. We knew nothing rightly for want of perspective. Now we learn what patient ages must round themselves before the rock is broken and the first lichen race has disintegrated the thinnest external plate into soil and opened the door for the remote flora, fauna, Ceres and Pomona to come in. How far off yet is the trilobite, how far the quadruped, how inconceivably remote is man! All duly arrive, and then race after race of men. It is a long way from granite to the oyster; farther yet to Plato and the preaching of the immortality of the soul. Yet all must come, as surely as the first atom has two sides."

It would be useless to multiply citations along this line to demonstrate not only that Emerson was an evolutionist, but that his whole philosophy was pervaded by the doctrine. It should be remembered that, at the time Emerson wrote, evolution had won wide favor among thinkers and that the success of the Origin of Species was an evidence, not of the creation of the evolution sentiment by that work, but of a pre-existing mental current in favor of evolution.

Very respectfully,

Harriet C. B. Alexander.

Chicago, *December 20, 1898.*

Editor's Table.

THE NEW SUPERSTITION.

THE death of a prominent man of letters in the hands of certain individuals of the "Christian Science" persuasion has given rise to a good deal of serious discussion as to the principles and practices of that extraordinary sect. That a considerable number of persons should have banded themselves together to ignore medical science, and apply "thought" as a remedy for all physical ills, has excited no little alarm and indignation in various quarters. Some of the severest criticisms of this outbreak of irrationality have come from the religious press, which takes the ground that, while the Bible doubtless contains numerous accounts of miraculous healing, it nevertheless fully recognizes the efficacy of material remedies. A "beloved physician" is credited with the authorship of one of the gospels and of the book of Acts. An apostle recommends a friend to "take a little wine for his stomach's sake and his often infirmities." The man who was attacked by robbers had his wounds treated in the usual way. The soothing effect of ointments is recognized; and the disturbing effects of undue indulgence in the wine cup are forcibly described. The peculiar character of a miracle, it is contended, lies in the fact that it passes over natural agencies; but, because these may be dispensed with by Divine Power, they are not the less specifically efficacious in their own place.

These, and such as these, are the arguments which are urged by the representatives of orthodox religion against the new heresy, or, as we have called it, "the new superstition." To argue against it on scientific grounds would be almost too ridiculous. When people make a denial of the laws of matter the basis of their creed, we can only leave them to work it out with Nature. They will find that, like all the world, they are subject to the law of gravitation and to the laws of chemistry and physics. If one of them happens to be run over by a railway train the usual results will follow; and so of a multitude of conceivable accidents. A Christian Scientist who "blows out the gas" will be asphyxiated just like anybody else; and if he walks off the wharf into the water he will require rescue or resuscitation just as if he were a plain "Christian" or a plain "scientist." Like Shylock, he is "fed with the same food, hurt with the same weapons, subject to the same diseases" as the rest of the community; and little by little the eternal course of things will chastise his extravagant fancies into reasonable accord with facts.

To tell the truth, we have not much apprehension that the health of the community will suffer, or the death rate go up, as the result of this new craze. On the contrary, we rather expect that any influence it may have in these respects will, on the whole, be for the better; and for a very simple reason: The laws of health are not so difficult to master, and, as every adherent of "Christian Science" will be anxious to reflect credit on it by the satisfactory condition of his or her personal health, we quite believe that in the new sect more diseases will be avoided than incurred. Moreover, the elevated condition of mind of these enthusiasts makes in itself for health, so long as it does not turn to hysteria.

We certainly can not refuse all sympathy to people who make it a principle to enjoy good health. Of course, if they were thoroughly consistent, they might do mischief in direct proportion to their numbers. A "Christian Science" school board who did not believe in ventilating or adequately warming school rooms, holding that it made no difference whether the children breathed pure air or air laden with carbon dioxide and ptomaines, or whether or not they were exposed to chills and draughts, would be about as mischievous a body of men as could well be imagined. If "Christian Science" in the house means an indifference to the ordinary physical safeguards of health, it will quickly make a very evil repute for itself. But, as we have already said, we do not anticipate these results. Having undertaken to avoid and to cure diseases by "thinking truth," we believe our friends of the new persuasion will think enough truth to get what benefit is to be got from cleanliness, fresh air, and wholesome food —and that will be quite a quantity.

EMERSON.

We publish on another page a letter from a correspondent who thinks that much injustice is done to Emerson in the remarks we quoted in our December number from Mr. J. J. Chapman's recent volume of essays. What Mr. Chapman said was, in effect, that Emerson had not placed himself in line with the modern doctrine of evolution—that he was probably "the last great writer to look at life from a stationary standpoint." Mrs. Alexander says in reply that Emerson was an evolutionist before Darwin, having learned the doctrine from Goethe and made it a fundamental principle of his philosophy. No one who has read Mr. Chapman's essay could think for a moment that there was any intention on his part to deal ungenerously or unfairly with the great writer of whom America is so justly proud; nor would many readers be disposed to question his competence to pronounce a sound judgment upon his subject. There must, therefore, it seems to us, be some way of reconciling the verdict of Mr. Chapman with the claims set forth in our correspondent's letter.

The true statement of the case doubtless is that Emerson received the doctrine of evolution—so far as he received it—as a poet. He welcomed the conception of a gradual unfolding of the universe, and a gradually higher development of life; but it dwelt in his mind rather as a poetical imagination than as a scientific theory. The consequence was that he was still able to speak in the old absolute manner of many things which the man of science can only discuss from a relative standpoint. When, for example, Emerson says, "All goes to show that the soul in man is not an organ, but animates and exercises all the organs; is not a function, like the power of memory, of calculation, of comparison, but uses these as hands and feet; is not a faculty, but a light; is not the intellect or the will, but the master of the intellect and the will; is the background of our being in which they lie—an immensity not possessed and that can not be possessed"—he may be uttering the sentence of a divine philosophy, or the deep intuition of a poet; but he is not speaking the language of science, nor evincing any sense of the restrictions which science might place on such expressions of opinion. Certainly he is not at the standpoint of evolution; and it is very hard to believe that the views he announces could in any way be harmonized with, say, Mr. Spencer's Principles of Psychology. Or take such a passage as the following: "All the facts of the animal economy—sex, nutriment, gestation, birth, growth—are symbols of the passage of the world into the soul of man, to suffer there a change and reappear a new and higher fact. He uses forms according to the life, and not according to the form. This is true science. The poet alone knows astronomy, chemistry, vegetation, and animation, for he does not stop at these facts, but employs them as signs. He knows why the plain or meadow of space was strewn with those flowers we call suns and moons and stars; why the great deep is adorned with animals, with men, and gods; for in every word he speaks he rides on them as the horses of thought." Now, we should be sorry to crumple one leaf in the laurel wreath of the poet; but is there much sense in saying that he is our only astronomer, or that he could inform us why suns and planets were disposed through space so as to make the forms we see? We do not think Goethe held these ideas; if he did, they were certainly not part of his evolution philosophy. The doctrine of evolution is not at war, we trust, with poetic inspiration; but if it teaches anything, it teaches that the world is full of infinite detail, and that without a certain mastery of details general views are apt to be more showy than solid. It also brings home to the mind very forcibly that one can only be sure of carefully verified facts, and, even of these, ought not to be too sure. It teaches that time and place and circumstance are, for all practical purposes, of the essence of the things we have to consider; that nothing is just what it would be if differently conditioned. There is nothing of which Emerson discourses with so much positiveness as the soul, an entity of which the serious evolutionist can only speak with all possible reserve. The evolutionist labors to construct a psychology; but Emerson has a psychology ready-made, and scatters its affirmations with a liberal hand through every chapter of his writings. That these are stimulating in a high degree to well-disposed minds we should be sorry to deny. They are a source, which for many long years will not run dry, of high thoughts and noble aspirations. No one has more worthily or loftily discoursed of the value of life than has the New England philosopher; and for this the world owes him a permanent debt of gratitude. But he was not an evolutionist in the modern sense—that is, in the scientific sense. If, as Mr. Chapman says, he was the last great writer to look at life from a stationary standpoint, then we can only add that the old philosophy had a golden sunset in his pages.

Scientific Literature.

SPECIAL BOOKS.

THERE are a great many different ways of conceiving the science of society, and until the study of the subject is more advanced than it is as yet, it would be rash to set up any one method as superior to all others. All that can reasonably be asked is that the subject should be approached with a competent knowledge of what has previously been thought and written in regard to it, that the aspects presented should possess intrinsic importance, and that the treatment should be scientific. The work which Professor *Giddings* has published under the title of *Elements of Sociology* * fulfills these conditions entirely, and we consider it, after careful examination, as admirably adapted to the purpose it is meant to serve—namely, as "a text book for colleges and schools." For use in schools—that is to say, in secondary schools of the ordinary range—the treatment may be a little too elaborate, but for college use we should say that it is, so far as method is concerned, precisely what is wanted. We do not know any other work which gives in the same compass so interesting and satisfactory an analysis of the constitution and development of society, or so many suggestive views as to the springs of social action and the conditions of social well-being. Professor Giddings writes in a clear and vigorous style, and the careful student will notice many passages marked by great felicity of expression. In a text-book designed to attract the young to a subject calling for considerable concentration of attention, this is an advantage that can hardly be overestimated.

In the first chapter the writer gives us his definition of society as "any group or number of individuals who cultivate acquaintance and mental agreement—that is to say, like-mindedness." The unit of investigation in sociology is declared to be the individual member of society, or, as the writer calls him, in relation to the investigation in hand, the "socius." Whether in strict logic the unit of investigation in *sociology* can be the individual, even granting, as must be done, that he is born social, is a point on which we are not fully satisfied. We should be disposed to think that the study of the individual was rather what Mr. Spencer would call a "preparation" for sociology than an integral part of the science itself. From a practical point of view, however, it must be conceded that a treatise on sociology would begin somewhat abruptly if it did not present in the first place an adequate description of the "socius," especially setting forth those qualifications and tendencies which fit and impel him to enter into relations with other members of the human race. Chapter V of the present work deals with The Practical Activities of Socii, and shows in an interesting manner what may be called the lines of approach of individuals to one another in society. Sometimes the approach is by means of conflict, and the writer shows how this may be a preparation for peaceful relations through the insight it gives into opposing points of view. He distinguishes between primary and secondary conflict—the first being a struggle in which one individual violently strives to suppress or subdue an opposing personality, the second a mere trial of differing opinions and tastes, leading often to a profitable readjustment of individual standpoints.

Chapter X, entitled The Classes of Socii, is an excellent one. The author classifies socii with reference (1) to vitality, (2) to personality—i. e. personal resource and capacity—and (3) to social feeling. Under the third classification he distinguishes (1) the social class, (2) the non-social class, (3) the pseudo-social class, and (4) the anti-social class. The first of these, the "social class," is well characterized as follows: "Their distinguishing characteristic is a consciousness of kind that is wide in its scope and strong

* The Elements of Sociology. By Franklin Henry Giddings. New York: The Macmillan Company, 1898. Pp. 353. Price, $1.10.

in its intensity. They are sympathetic, friendly, helpful, and always interested in endeavoring to perfect social relations, to develop the methods of co-operation, to add to the happiness of mankind by improving the forms of social pleasure, to preserve the great social institutions of the family and the state. To this class the entire population turns for help, inspiration, and leadership, for unselfish loyalty and wise enterprise. It includes all who in the true sense of the word are philanthropic, all whose self-sacrifice is directed by sound judgment, all true reformers whose zeal is tempered by common sense and sober patience, and all those who give expression to the ideals and aspirations of the community for a larger and better life." The Pre-eminent Social Class is further discussed in Chapter XII; and the subsequent chapters, as far as, and including, XIX, describe the processes by which social results in the balancing of interests, establishment of rights, assimilation of characters, and general improvement of social conditions, are realized. The limits which expediency sets to the pursuit of "like-mindedness" are well shown, and the advantage and necessity for social progress of free discussion and wide toleration of individual differences are strongly insisted on. Chapter XX deals with The Early History of Society, and contains the statement that "from an apelike creature, no longer perfectly represented in any existing species, the human race is descended."

The subject of Democracy is well treated in a special chapter (XXIV). The author is of opinion that, if the natural leaders of society do their duty, they will wield a moral influence that will give a right direction to public policy, and secure the continuous advance of the community in prosperity and true civilization. The "if" is an important one, but the author has strong hope, in which all his readers will certainly wish to share, that in the main everything will turn out well.

The remarks on the State in Chapter XXIII are, as far as they go, judicious; but we could have wished that the author, who we are sure desires to make his treatise as practically useful as possible, had dwelt somewhat on the dangers of over-legislation, and had brought into fuller relief than he has done the difference between state action and voluntary enterprise, arising from the fact that the former always involves the element of *compulsion*. We pass a law when we can not get our neighbor to co-operate or agree with us in something, and consequently resolve to compel him. Surely this consideration should suffice to make parsimony the first principle of legislation. We agree with our author that it is not well to "belittle" the state (page 214), but it is hardly belittling the state to wish to be very sparing in our appeals to it for the exercise of coercive power.

We miss also in the work before us such a treatment of the *family* as might have been introduced into it with advantage. The family certainly has an important relation to the individual, and in all civilized countries it is specially recognized by the state. Mr. Spencer, in the chapter of his Study of Sociology entitled Preparation in Psychology, has dwelt on the encroachments of the state on the family; and Mr. Pearson, in his National Life and Character, published half a dozen years ago, sounded a note of alarm on the same subject. What position Professor Giddings would have taken as to the importance of family life and the rights and duties of the family we do not, of course, know; but we are disposed to think he could have increased the usefulness and interest of his book by some discussion of these points. We would only further say that, while the book is specially intended for scholastic use, it is well adapted for general reading, and that it could not be read carefully by any one without profit.

Prof. *Wesley Mills* holds the opinion that in the present stage of the study of animal life,* facts are much more desirable than theories. Experiment and observation must go on for many years before generalizations will be worth the making. Putting this belief into practice, he has bred and reared a large number of animals, making most careful notes on their physical and mental development, and furnishes in his book, resulting from these studies, a contribution of unquestionable value to comparative psychology.

In his investigation of the habits of squirrels, he finds the red squirrel, or chickaree, much more intelligent than the chipmunk. The latter is easily trapped, but the former profits by experience and is rarely secured a second time. These little creatures are also adepts in feigning. Two examples are cited in which squirrels apparently ill recovered rapidly when left alone and made their escape in vigorous fashion. Many instances of animals shamming death are judged to be cases of catalepsy induced by excessive fear. The chickaree is also credited with some musical capacity. one being observed, when excited, to utter tones that were birdlike; whence it is concluded "likely that throughout the order *Rodentia* a genuine musical appreciation exists, and considerable ability in expressing states of emotion by vocal forms."

While experimenting with hibernating animals, Professor Mills kept a woodchuck in confinement five years, and noted that it had a drowsy or torpid period from November to April. Another specimen subjected to the same conditions did not hibernate for an hour during the entire season. Bats began to hibernate at 45° to 40° F., and were so affected by temperature that they could be worked like a machine by varying it. The woodchuck, however, was comparatively independent of heat and cold, but very sensitive to storms. This is found to be true of many wild animals, that they "have a delicate perception of meteorological conditions, making them wiser than they know, for they act reflexly."

Some records are given of cases of lethargy among human beings, and in regard to these, as well as normal sleep and hibernation, it is suggested that their conditioning and variability throw great light upon the evolution of function.

In order to observe closely the psychic development of young animals, Professor Mills raised families of dogs, cats, chickens, rabbits, guinea-pigs, and pigeons. The data obtained by him, given in the form of diaries with comparisons and conclusions, constitute Part III, the larger half of the book, unquestionably first in importance and interest. It is scarcely possible to overvalue careful studies like these, undertaken not to justify theories, but to bring to light whatever truths may be apprehended of the nature of growth and connection of mind and body.

The last division of the book contains the discussions on instinct by Professors Mills, Lloyd Morgan, Baldwin, and others, first published in Science. The beginning of the volume, devoted to a general considera-

* The Nature and Development of Animal Intelligence. By Wesley Mills, F. R. S. C. New York: The Macmillan Company. Pp. 307. Price, $2.

tion of the subject, consists of papers on methods of study and comparative psychology which have appeared in various scientific periodicals, including this magazine.

GENERAL NOTICES.

In *Four-Footed Americans and their Kin** a similar method is applied by *Mabel Osgood Wright* to the study of animals to that which was followed with reference to ornithology in Citizen Bird. The subject is taught in the form of a story, with dramatic incident and adventure, and miniature exploration, and the animals are allowed occasionally to converse and express their opinions and feelings. The scene of the action is "Orchard Farm and twenty miles around." Dr. Hunter and his daughter and colored "mammy" have returned there to their home after several years of travel, with two city youths who have been invited to spend the summer at the place and are told the story of the birds. Another family have come to make an autumn visit, but it is arranged that they should spend the winter at the farm. "What they did, and how they became acquainted with the four-footed Americans, is told in this story." Most of the common animals of the United States are met or described in the course of the party's wandering, as creatures of life rather than as in the cold and formal way of treating museum specimens, and a great deal of the lore of other branches of natural history is introduced, as it would naturally come in in such excursions as were taken. The scientific accuracy of the book is assured by the participation of Mr. Frank M. Chapman as editor. At the end a Ladder for climbing the Family Tree of the North American Mammals is furnished in the shape of a table of classification; and an index of English names is given. The illustrations, by Ernest Seton Thompson, give lifelike portraits and attitudes and are very attractive.

St. George Mivart, whose enviable reputation as a specialist in natural history has perhaps given some justification for his attempts at philosophy, has recently published a new philosophical work entitled *The Groundwork of Science.** It is an effort to work out the ultimate facts on which our knowledge, and hence all science, is based. A short preface and introductory chapter are devoted to a statement of the aims of the work and some general remarks regarding the history of the scientific method. An enumeration of the sciences and an indication of some of their logical relations are next given. The third chapter, entitled The Objects of Science, is given up chiefly to a refutation of idealism. The methods of science, its physical, psychical, and intellectual antecedents, language and science, causes of scientific knowledge, and the nature of the groundwork of science are the special topics of the remaining chapters. The general scheme of the inquiry is based on the theory that the groundwork of science consists of three divisions. "The laborers who work, the tools they must employ, and that which constitutes the field of their labor. . . . Science is partly physical and partly psychical. . . . The tools are those first principles and universal, necessary, self-evident truths which lie so frequently unnoticed in the human intellect, and which are absolutely indispensable for valid reasoning. . . . The nature of the workers must also be noticed as necessarily affecting the value of their work. . . . And, last of all, a few words must be devoted to the question whether there is any and, if any, what foundation underlying the whole groundwork of science." The result at which the author arrives is stated as follows: "The groundwork of science is the work of self-conscious material organisms making use of the marvelous first principles which they possess in exploring all the physical and psychical phenomena of the universe, which sense, intuition, and ratiocination can anyhow reveal to them as real existences, whether actual or only possible. . . . The foundation of science can only be sought in that

* Four-Footed Americans and their Kin. By Mabel Osgood Wright. Edited by Frank M. Chapman. New York: The Macmillan Company. Pp. 432, with plates. Price, $1.50.

* The Groundwork of Science. A Study of Epistemology. By St. George Mivart. Pp. 328. Price, $1.75. New York: G. P. Putnam's Sons. London; Bliss, Sands & Co.

reason which evidently to us pervades the universe, and is that by which our intellect has been both produced and illumined."

A large amount of information, mainly of a practical character, has been gathered by Mr. *William J. Clark* in his book on *Commercial Cuba* *—information, as Mr. Gould well says in the introduction he has contributed to the work, covering almos tthe entire field of inquiry regarding Cuba and its resources. The data have been partly gained from the author's personal observation and during his travels on the island, and partly through laborious and painstaking classification of existing material, collected from many and diverse sources. The subject is systematically treated. The first chapter—How to Meet the Resident of Cuba—relates to the behavior of visitors to the island, really a considerably more important matter than it would be in this country, for the Spaniards are strict in their regard for correct etiquette. It is natural that a chapter on the population and its characteristics and occupations should follow this. Even more important than correct behavior—to any one at least but a Spaniard—is the subject of climate and the preservation of health; and whatever is of moment in relation to these subjects is given in the chapter devoted to them. Next the geographical characteristics of Cuba are described, and the facilities and methods of transportation and communication; also social and political matters, including government, banking, and commercial finance, and legal and administrative systems of the past and future. A chapter is given to Animal and Vegetable Life, another to Sugar and Tobacco, and a third to Some General Statistics, after which the several provinces—Pinar del Rio, the city and province of Havana (including the Isle of Pines), and the provinces of Matanzas, Santa Clara, Puerto Principe, and Santiago—are described in detail, with their physical characteristics, their agricultural or mining resources, their various towns, and whatever else in them is of interest to the student of economics. A Cuban Business Directory is given in the appendix.

* Commercial Cuba. A Book for Business Men. By William J. Clark. Illustrated. New York: Charles Scribner's Sons. Pp. 514, with maps.

A Collection of Essays is the modest designation which Professors *J. C. Arthur* and *D. T. MacDougal* give to the scientific papers included in their book on *Living Plants and their Properties.** The authors deserve all praise for having taken the pains without which no book composed of occasional pieces can be made complete and symmetrical, to revise and rewrite the articles, omitting parts "less relevant in the present connection," and amplifying others "to meet the demands of continuity, clearness, and harmony with current botanical thought." Of the twelve papers, those on the Special Senses of Plants, Wild Lettuce, Universality of Consciousness and Pain, Two Opposing Factors of Increase, The Right to Live, and Distinction between Plants and Animals, are by Professor Arthur; and those on The Development of Irritability, Mimosa—a Typical Sensitive Plant, The Effect of Cold, Chlorophyll and Growth, Leaves in Spring, Summer, and Autumn, and the Significance of Color, are by Professor MacDougal. Based to a large extent on original investigations or careful studies, they present many novel thoughts and aspects, and constitute an acceptable addition to popular botanical literature.

Having described the great and growing interest taken in child study, President *A. R. Taylor* announces as the principal aim of his book, *The Study of the Child*,† to bring the subject within the average comprehension of the teacher and parent. Besides avoiding as much as possible technical terms and scientific formulas, the author has made the desire to announce new principles subservient to that of assisting his fellow-workers to a closer relationship with the child. As teachers and parents generally think it extremely difficult to pursue the study of the child without at least a fair understanding of the elements of psychology, the author intimates

* Living Plants and their Properties. A Collection of Essays. By Joseph Charles Arthur (Purdue University) and Daniel Trembly MacDougal (University of Minnesota). New York: Baker & Taylor. Minneapolis: Morris & Wilson. Pp. 234.

† The Study of the Child. A Brief Treatise on the Psychology of the Child, with Suggestions for Teachers, Students, and Parents. By A. R. Taylor. New York: D. Appleton and Company. (International Education Series.) Pp. 215. Price, $1.50.

that they often forget that the study will give them that very knowledge, and that, properly pursued, it is the best possible introduction to psychology in general. Every chapter in the present book, he says, is an attempt to organize the knowledge already possessed by those who know little or nothing of scientific psychology, and to assist them to inquiries which will give a clearer apprehension of the nature and possibilities of the child. The treatise begins with the wakening of the child to conscious life through the senses, the nature and workings of each of which are described. The bridge over from the physical to the mental is found in consciousness, which for the present purpose is defined as the self knowing its own states or activities. The idea of identity and difference arises, symbols are invented or suggested, and language is made possible. The features of language peculiar to children are considered. Muscular or motor control, the feelings, and the will are treated as phases or factors in development, and their functions are defined. The intellect and its various functions are discussed with considerable fullness; and chapters on The Self, Habit, and Character; Children's Instincts and Plays; Manners and Morals; Normals and Abnormals; and Stages of Growth, Fatigue Point, etc., follow. A very satisfactory bibliography is appended.

*The Discharge of Electricity through Gases** is an expansion of four lectures given by the author, Prof. *J. J. Thomson*, of the University of Cambridge, at Princeton University in October, 1896. Some results published between the delivery and printing of the lectures are added. The author begins by noticing the contrast between the variety and complexity of electrical phenomena that occur when matter is present in the field with their simplicity when the ether alone is involved; thus the idea of a charge of electricity, which is probably in many classes of phenomena the most prominent idea of all, need not arise, and in fact does not arise, so long as we deal with the ether alone. The questions that occur when we consider the relation between matter and the electrical charge carried by it—such as the state of the matter when carrying the charge, and the effect produced on this state when the sign of the charge is changed—are regarded as among the most important in the whole range of physics. The close connection that exists between chemical and electrical phenomena indicates that a knowledge of the relation between matter and electricity would lead to an increase of our knowledge of electricity, and further of that of chemical action, and, indeed, to an extension of the domain of electricity over that of chemistry. For the study of this relation the most promising course is to begin with that between electricity and matter in the gaseous or simpler state; and that is what is undertaken in this book. The subject is presented under the three general headings with numerous subheadings of The Discharge of Electricity through Gases, Photo Electric Effects, and Cathode Rays.

For a clear and concise presentation of the framework of psychology and its basal truths, the *Story of the Mind** may be commended. Although the space afforded is only that of a bird's-eye view, no skeleton bristling with technical terms confronts us, but an attractive and well-furnished structure with glimpses of various divisions that tempt us to further examination. The text is simply and charmingly written, and may induce many to search the recesses of psychology who, under a less skillful guide, would be frightened away. A bibliography at the end of the volume supplies what other direction may be needed for more advanced study. Admirable in construction and treatment as the book is, there are, however, paths in which we can not follow where Professor Baldwin would lead, and in others that we undertake with him we do not recognize our surroundings as those he describes. This is especially the case with the environment of the genius. We do not find that "he and society agree in regard to the fitness of his thoughts," nor that "for the most part his judgment is *at once* also the social judgment." If such were the case, how would he "wait for recognition," or be

* The Discharge of Electricity through Gases. Lectures delivered on the occasion of the Sesquicentennial Celebration of Princeton University. By J. J. Thomson. New York: Charles Scribner's Sons. Pp. 203. Price, $1.

* The Story of the Mind. By James Mark Baldwin. New York: D. Appleton and Company. Pp. 232. Price, 40 cents.

"muzzled" for expressing his thoughts? In almost all cases it is the story of Galileo over again. In art, science, and social reform he sees far beyond his fellows. Society can not accept him because it has not the vision of a genius. He contradicts its judgment and is fortunate when he escapes with the name of "crank." The military hero does not enter into this category: he glorifies the past rather than the future; he justifies the multitude in a good opinion of itself and, is therefore always received.

The first edition of Professor *Bolton's Catalogue of Scientific and Technical Periodicals** was issued in 1885, and was intended to embrace the principal independent periodicals of every branch of pure and applied science, published in all countries from the rise of this literature to the present time, with full titles, names of editors, sequence of series, and other bibliographical details, arranged on a simple plan convenient for reference; omitting, with a few exceptions, serials constituting transactions of learned societies. In cases where the scientific character of the journal or its right to be classed as a periodical was doubtful, and in other debatable cases, the compiler followed Zuchold's maxim, that "in a bibliography it is much better that a book should be found which is not sought, than that one should be sought for and not found." The new edition contains as Part I a reprint from the plates of the first edition, with such changes necessary to bring the titles down to date as could be made without overrunning the plates; and in Part II additions to the titles of Part I that could not be inserted in the plates, together with about 3,600 new titles, bringing the whole number of titles up to 8,477, together with addenda, raising this number to 8,603, minus the numbers 4,955 to 5,000, which are skipped between the first and second parts. Chronological tables give the dates of the publication of each volume of the periodicals entered. A library check list shows in what American libraries the periodicals may be found. Cross-references are freely introduced. The material for the work has been gathered from all available bibliographies, and by personal examination of the shelves and catalogues of many libraries in the United States and Europe, and from responses to circulars sent out by the Smithsonian Institution. The whole work is a monument of prodigious labor industriously and faithfully performed.

In *Theories of the Will in the History of Philosophy** a concise account is given by *Archibald Alexander* of the development of the theory of the will from the early days of Greek thought down to about the middle of the present century; including, however, only the theories of the more important philosophers. In addition to contributing something to the history of philosophy, it has been the author's purpose to introduce in this way a constructive explanation of voluntary action. The account closes with the theory of Lotze; since the publication of which the methods of psychology have been greatly modified, if not revolutionized, by the development of the evolutional and physiological systems of study. The particular subjects considered are the theories of the will in the Socratic period, the Stoic and Epicurean theories; the theories in Christian theology, in British philosophy from Bacon to Reid, Continental theories from Descartes to Leibnitz, and theories in German philosophy from Kant to Lotze. The author has tried to avoid obtruding his own opinions, expressing an individual judgment only on matters of doubtful interpretation; and he recognizes that speculation and the introspective method of studying the will appear to have almost reached their limits.

Dr. *Frank Overton's* text-book of *Applied Physiology* † makes a new departure from the old methods of teaching physiology, in that it begins with the cells as the units of life and shows their relations to all the elements of the body and all the processes of human action. The fact of their fundamental nature and importance is emphasized

* A Catalogue of Scientific and Technical Periodicals, 1665–1895, together with Chronological Tables and a Library Check List. By Henry Carrington Bolton. Second edition. City of Washington: Published by the Smithsonian Institution. Pp. 1247.

* Theories of the Will in the History of Philosophy. By Archibald Alexander. New York: Charles Scribner's Sons. Pp. 357. Price, $1.50.

† Applied Physiology for Advanced Grades. Including the Effects of Alcohol and Narcotics. American Book Company. Pp. 432. Price, 80 cents.

throughout. The relation of oxidation—oxidation within the cells—as the essential act of respiration—to the disappearance of food, the production of waste matters, and the development of force, is dwelt upon. The influence of alcohol is discussed in all its aspects, not in a separate chapter, but whenever it comes in place in connection with the several topics and subjects treated. Other narcotics are dealt with. A chapter on inflammation and taking cold is believed to be an entirely new feature in a school text book. Summaries and review topics are arranged at the end of each chapter; subjects from original demonstrations and the use of the microscope are listed; and many hygienic topics, such as air, ventilation, drinking water, clothing, bathing, bacteria, etc., are specially treated.

The prominent characteristic of Professors *F. P. Venable* and *J. L. Howe's* text-book on *Inorganic Chemistry according to the Periodic Law* * is expressed in the title, and is the adoption of the periodic law as the guiding principle of the treatment, and the keeping of it in the foreground throughout. So far as the authors have noticed, the complete introduction of this system has not been attempted before in any text book. They have made the experiment of following it closely in their classes, and their success through several years has convinced them of its value. "In no other way have we been able to secure such thorough results, both as to thorough, systematic instruction and economy of time. The task is rendered easier for both student and teacher." After the setting forth of definitions and general principles in the introduction, the elements are taken up and described according to their places and relations in the periodic groups, and then their compounds are described successively, with hydrogen, the halogens, oxygen, sulphur, and the nitrides, phosphides, carbides, silicides, and the alloys. The treatment is systematic, condensed, and clear.

The purpose of Mr. *John W. Troeger's* series of Nature-Study Readers is declared by the editor to be to supply supplementary reading for pupils who have been two years or more at school. They are composed, moreover, with a view to facilitating the recognition in the printed form of words already familiar to the ear, and to making the child at home with them. In carrying out this purpose the author takes advantage of the child's fondness for making observations, especially when attended by his companions or elders. In doing this the aim has been kept in view not to weary the child with details, and yet to give sufficient information to lead to accurate and complete observations. Most of the chapters in the present volume, *Harold's Rambles*, the second of the series, contain the information gleaned during walks and short excursions. Among the subjects concerned are birds, mammals, insects, earthworms, snails, astronomy, minerals, plants, grasses, vegetables, physics, and features connected with the farm. These Nature-study readers are published as a branch of Appletons' Home-Reading series. (New York: D. Appleton and Company. Price, 40 cents.)

Another of Appletons' Home-Reading Books is *News from the Birds*, which the author, *Leander S. Keyser*, explains has been written with two purposes in mind: first, to furnish actual instruction, to tell some new facts about bird life that have not yet been recited; and, second, to inspire in readers a taste for Nature study. It is by no means a key for the identification of the birds; but, instead of telling all that is or may be known respecting a particular bird, the author has sought only to recite such incidents as will spur the reader to go out into the fields and woods and study the birds in their native haunts. For the most part the author has given a record of his own observations, and not a reiteration of what others have said. He has gone to the birds themselves for his facts, and has made very little use of books.

It has been Mr. *Ernest A. Congdon's* aim, in preparing his *Brief Course in Qualitative Analysis* (New York: Henry Holt; 60 cents), to render it as concise as possible while making the least sacrifice of a study of reactions and solubilities of chemical importance. The manual covers the points of preliminary reactions on bases and acids; schemes of analysis for bases and acids; explanatory notes on the analyses; treatment of solid substances

* Inorganic Chemistry according to the Periodic Law. By F. P. Venable and James Lewis Howe. Easton, Pa: The Chemical Publishing Company. Pp. 266. Price, $1.50.

(powders, alloys, or metals); and tables of solubilities of salts of the bases studied. A comprehensive list of questions, stimulative of thought, is appended. The book is intended merely as a laboratory guide, and should be supplemented by frequent "quiz classes" and by constant personal attention. The course has been satisfactorily given in the Drexel Institute within the allotted time of one laboratory period of four hours, and one hour for a lecture or quiz per week, during the school year of thirty-two weeks.

Lest we Forget is the title which Presideni *David Starr Jordan* has given to his address before the graduating class of Leland Stanford Junior University, May 25, 1898—"lest we forget" the dangers and duties and responsibilities laid upon us by the war with Spain. Though delivered before the "policy of expansion" was fully developed, the address describes with prophetic accuracy the dream of imperialism with which the minds even of men usually sane and honest have become infected, and points out a few of the logical results to which they would lead, and the dangers which will have to be incurred in gratifying them. We cite a few of the strong points made by the author: "Our question is not what we shall do with Cuba, Porto Rico, and the Philippines; it is what these prizes will do to us" "Shall the war for Cuba Libre come to an inglorious end? If we make anything by it, it will be most inglorious." "I believe that the movement toward broad dominion, so eloquently outlined by Mr. Olney, would be a step downward."

PUBLICATIONS RECEIVED.

Adams, Enos, 2072 Second Avenue, New York. What is Science? Pp. 14.

Agricultural Experiment Stations. Bulletins. Delaware College: No. 41. Pea Canning in Delaware. By G. H. Powell. Pp. 16.—New Hampshire College: No. 55. The Feeding Habits of the Chipping Sparrow. By C. M. Weed. Pp. 12; No. 56. Poisonous Properties of Wild Cherry Leaves. By F. W. Morse and C. D. Howard. Pp 12.—New Jersey: No. 130. Forage Crops. By E. B. Voorhees and C. B. Lane. Pp. 22; No. 131. Feeds Rich in Protein, etc. By E. B. Voorhees. Pp. 14.—New York: No. 145. Analysis of Commercial Fertilizers. By L. L. Van Syke. Pp. 100.—United States Department of Agriculture. Some Books on Agriculture and Sciences related to Agriculture published in 1896-'98. Pp. 45.; List of Publications relating to Forestry in the Department Library. Pp. 93.

Allen, W. D., and Carlton. W. N., Editors In Lantern Land, Vol. I, No. 1, December 3, 1898. Monthly. Hartford, Conn. Pp. 16. 10 cents.

Amryc, C. Pantheism, the Light and Hope of Modern Reason. Pp. 302.

Anthropological Institute of Great Britain and Ireland, The Journal of. New Series, Vol. I, Nos. 1 and 2, August and November, 1898. London: Kegan Paul, Trench, Trübner & Co. Pp. 200

Atkinson, Edward. I. The Cost of a National Crime. II. The Hell of War and its Penalties. Brookline, Mass. Pp. 26.

Babcock Printing Press Manufacturing Company. Some Facts about Modern Presses. Pp. 8.

Brinton, Daniel G. A Record of Study on Aboriginal American Languages. Pp. 24.

Bulletins, Proceedings, and Reports. American Society of Naturalists: Records, Vol. II, Part 3. Providence, R. I.: Published by the Society. Pp. 58.—Argentine Republic. Anales de la Oficina Meteorologica Argentina, Vol. XII. Climate of Asuncion, Paraguay, and Rosario de Santa Fé. Walter G. Davis, Director. Buenos Aires. Pp. 684.—Association of Economic Entomologists: Proceedings of the Tenth Annual Meeting. Washington: United States Department of Agriculture. Pp. 104.—Illinois State Laboratory of Natural History: Biennial Report of the Director for 1897-'98. Urbana, Ill. Pp. 31, with plates.—Johns Hopkins University Circulars: Notes from the Biological Laboratory, November, 1898. Pp. 34. 10 cents.—Secretary of the Interior: Report for the Fiscal Year ended June 30, 189-. Pp. 242.—Wagner Free Institute of Science of Philadelphia: Transactions, Vol. III, Part IV, April, 1898. Pp. 150, with plates.

De Morgan, Augustus. On the Study and Difficulties of Mathematics. New edition. Chicago: The Open Court Publishing Company. Pp. 288.

Gowdy, Jean L. Ideals and Programmes. Syracuse, N. Y.: C. W. Bardeen. Pp. 102. 75 cents.

Grand View Institute Journal. Monthly. Grand View, Texas. Vol. I, No. 1, October, 1898. Pp. 18.

Hinsdale, Guy, M. D. Acromegaly. Detroit, Mich.: W. M. Warren. Pp. 88.

Holland, W J. The Butterfly Book. A Popular Guide to a Knowledge of the Butterflies of North America. New York: Doubleday & McClure Company. Pp. 382, with 48 colored plates. $3.

James, Alice J. Catering for Two. New York: G. P. Putnam's Sons Pp. 292. $1.25.

Lagrange, Joseph Louis. Lectures on Elementary Mathematics. Translated by T. J. McCormick. Chicago: Open Court Publishing Company. Pp. 172. $1.

Loomis, Ernest. Practical Occultism. Chicago: Ernest Loomis & Co., 70 Dearborn Street. Pp. 155. $1.25.

Merrill, G. P. The Physical, Chemical, and Economic Properties of Building Stones. Baltimore: Johns Hopkins Press. Pp. 80.

National Pure Food and Drug Congress: Memorial to Congress against Adulterations. Pp. 15.

Owen, Luella A. Cave Regions of the Ozark and Black Hills. Cincinnati: The Editor Publishing Company. Pp. 228.

Payson, E. P. Suggestions toward an Applied Science of Sociology. New York: G. P. Putnam's Sons. Pp. 237.

Reprints. Baldwin, J. Mark. Princeton Contributions to Psychology, Vol. II, No. 4, May, 1898. Pp. 32.—Brinton, Daniel G. The Linguistic Cartography of the Chaco Region. Pp 30.—Gerhard, William Paul. Theater Sanitation. Pp. 15.—Kuh, Sydney, M. D. The Medico-Legal Aspects of Hypnotism. Pp 12.—McBride, T. H. Public Parks for Iowa Towns. Pp 8.—Macmillan, Conway. On the Formation of Circular Muskeag in Tamarack Swamps. Pp. 8, with 3 plates.—Smith, J. P. The Development of Lytoceras and Phylloceras. San Francisco. Pp. 24, with plates.—Stuver, E., M. D. What Influence do Stimulants and Narcotics exert on the Development of the Child? Chicago. Pp. 20.—Turner, H. W. Notes on Some Igneous, Metamorphic, and Sedimentary Rocks of the Coast Ranges of California. Chicago. Pp. 16.—Washburn, F. L., Eugene, Ore. Continuation of Experiment in Propagating Oysters on the Oregon Coast, Summer of 1898. Pp. 5.

Spencer, Herbert, The Principles of Biology. Revised and enlarged edition, 1898. Vol. I. New York: D. Appleton and Company. Pp. 706. $2.

Winthrop, Alice Worthington. Diet in Illness and Convalescence. New York: Harper & Brothers. Pp. 287.

United States Geological Survey. The Kaolins and Fire Clays of Europe, and the Clay-working Industry of the United States in 1897. By Heinrich Ries. Pp. 114; Bulletin No. 150. The Educational Series of Rock Specimens collected and distributed by the Survey. By J. S. Diller. Pp. 400; No. 151. The Lower Cretaceous Gryphæas of the Texas Region. By R. T. Hill and T. W. Vaughan. Pp. 139, with plates; No. 152. Catalogue of the Cretaceous and Tertiary Plants of North America. By F. H. Knowlton. Pp. 247; No. 153. A Bibliographical Index of North American Carboniferous Invertebrates. By Stuart Weller. Pp. 653; No. 154. A Gazetteer of Kansas. By Henry Gannett. Pp. 246; No. 155. Earthquakes in California in 1896 and 1897. By C. D. Perrine. P. 18; No. 156. Bibliography and Index of North American Geology, Paleontology, Petrology, and Mineralogy for 1897. By F. B. Weeks. Pp. 130.

United States National Museum. Bean, Barton A. Notes on the Capture of Rare Fishes. Pp. 2.—Bean, Tarleton H. and Barton A. Notes on Oxycoltus Acuticeps (Gilbert) from Sitka and Kadiak, Alaska. Pp 2.—Lucas, F. A. A New Snake from the Eocene of Alabama. Pp. 2, with 2 plates.

Fragments of Science.

Early Submarine Telegraphy.—The actual date of the beginning of subaqueous telegraphy was admitted by Professor Ayrtoun, in a lecture delivered before the Imperial Institute in 1897, to be uncertain. Baron Schilling is said to have exploded mines under the Neva by means of the electric current as early as 1812; and this method was used by Colonel Pasley to blow up the wreck of the Royal George at Spithead in 1838; but our Morse has the credit of having first used a wire insulated with India rubber under water. In 1837, Wheatstone and Cooke were experimenting with land telegraphy, and were considering the possibility of laying an insulated wire under water. Morse's successful experiments date from 1842, when he personally laid a cable between Castle Garden and Governor's Island and sent messages over it; the next morning it was broken. With the introduction of gutta percha as an insulator in 1847, submarine telegraphy became practicable. The Central Oceanic Telegraph Company had been registered by Jacob Brett in 1845, and a cable was laid under the English Channel by Brett and his brother in 1850. Messages were sent through it, but, like Morse's earlier effort, it immediately became silent. Better success attended the cable of the next year, which was sheathed with iron; and the first public submarine message was sent over it November 13, 1851. Morse wrote of the possibility of establishing electro-magnetic communication across the ocean as early as 1844. A syndicate was formed for this purpose in 1855, Cyrus W. Field being the most conspicuous figure in it. An understanding was reached with the Brett company, and the Atlantic Telegraph Company was formed. The first effort to lay the cable was made in 1857 by the United States frigate Niagara and H. M. S. Agamemnon, but the wires broke in deep water when about a third of the work was done. A cable was successfully laid the next year, but it died out in a month. Finally, electric communication was permanently established across the Atlantic by the Telegraph Construction and Maintenance Company, which, capturing a cable that had been lost, soon had two. Transatlantic cables have now become so numerous and so regular in their working that the danger of even a temporary failure has become very remote.

The White Lady Mountain.—Iztaccihuatl (pronounced Is-tak-see-watl) is about ten miles, measuring to its principal peak, north of Popocatepetl. In shape it consists of a long, narrow ridge cut into three well-defined peaks about equally distant from one another, of which the central is the highest; and the snow-covered peak resembles the figure of a woman lying on her back; whence the name of the mountain, which means *white woman.* According to the Aztecs, Dr. O C. Farrington, of the Field Columbian Museum, tells us, this woman was a goddess who for some crime had been struck dead and doomed to lie forever on this spot. Popocatepetl was her lover, and had stood by her. Tastes differ as to whether it or Popocatepetl presents a more striking view, but either is a beautiful enough object to look upon. The first authenticated record of an ascent to the summit of the mountain is that of Mr. H. Reniere Whitehouse, who reached the top November 9, 1889, and found there undoubted evidence that an ascent had been made five days previously by Mr. James de Salis. Prof. Angelo Heilprin and Mr. F. C. Baker attempted an ascent in the following April, but were turned back when about seventy-five yards below the summit, at a height of 16,730 feet, by two impassable crevasses. "The ascent of Iztaccihuatl seems, therefore, pretty generally to have foiled those who have attempted it. Dr. Farrington, who ascended to the Porfirio Diaz Glacier in February, 1896, describes the route as steeper than that which leads up to Popocatepetl." The brilliant and varied flora, picturesque barrenness, and beautiful cascades lend everywhere a charm to the scene which contrasts favorably with the somber monotony which characterizes the route by which Popocatepetl is ascended. The slopes of the mountain are cultivated to a considerable height—10,860 feet. The lower slopes are largely covered with soil, and the andesite rock, of gray and red colors, differs completely in character from that of Popocatepetl. The aiguillelike character of many of the spurs extending at right angles to the course of the mountain is a prominent feature. Many caves in the rock furnish shelter to cattle aud persons attempting the ascent. Dr. Farrington examined the Porfirio Diaz Glacier, and concluded that it formerly had a much greater extent than now.

The Adulteration of Butter with Glucose.—The following is from an article by C. A. Crampton in the Journal of the American Chemical Society: In domestic practice the addition of sugar to butter for purposes of preservation is doubtless almost as old as the art of butter-making itself; salt, however, is the usually preferred preservative. Sugar appears in several of the various United States patents for so-called "improving" or renovating processes for butter, being added to it along with salt, saltpeter, and in some cases sodium carbonate. Within the past few years glucose has been used in butter specially prepared for export to tropical countries, as the West Indies or South America. It is usually put up in tins, and various means are resorted to for preventing the decomposition of their goods before they reach the consumer. Very large quantities of salt are used by the French exporters, as the following two analyses show:

	Butter for Export. To Brazil.	To Antilles.
Water	10.29	10.19
Curd	1.24	1.31
Ash	10.29	10.06
Fat	78.18	78.44
	100.00	100.00

Chemical antiseptics, borax, salicylic acid, etc., are sometimes used, but the method found most efficacious by exporters in this country seems to be the use of glucose in conjunction with moderately heavy salting. The glucose used is a heavy, low-converted sirup, known as confectioners' glucose. The detection of glucose in butter presents no difficulty. The butter is thoroughly washed with hot water, which will readily take up whatever glucose is preseut. This solution is then tested by means of Fehling's solution. The following is an analysis of the so-called *beurre rouge*, or red butter, which is exported to Guadeloupe. It is a peculiar highly colored compound, containing large quantities of salt and glucose:

Water	21.60
Curd	0.81
Ash	16.42
Fat	51.15
Glucose	10.02
	100.00

Decorated Skulls and the Power ascribed to them.—A collection of sixteen skulls—eight of men, seven of women, and one of a child—from New Guinea, is described by George A. Dorsey in the publications of the Field Columbian Museum, Chicago. They were received from a native chief, who used them for the adornment of his house, and is said to have prized them as trophies of war. They are decorated in the frontal region by engraved designs, and the parts are attached to one another by very skillfully adjusted cords. The ornamentation and the bindings are the subject of a special comment by William H. Holmes. Importance is attached by natives of New Guinea to the preservation of the skulls of friends as mementoes and of foes as trophies, and of both categories on account of the virtue—the best qualities of the individuals whose skulls they are—which they are supposed to impart in some mysterious way to their possessor. Hence special care is taken to have them preserved in detail, and that no part be lost. In the present specimens the jaws were secured by fastenings at right and left and in front. The teeth were carefully tied in, and when lost were replaced by artificial teeth. A cord was fastened around the back molar on one side, and carried along, inclosing each tooth in turn, in a loop, so as to make a very effective fastening when the cord was tightly drawn and attached to the back molar on the other side. The lower jaw was very firmly fastened to the skull by closely wrapped cords tightened by binding the strands around the middle portion. In some cases these fastenings are very elaborate and neat; in others, imperfect and slovenly. All the skulls in the collection are decorated with designs engraved on the frontal bone, and in some cases the figures run back. The execution of the work is not of a very high order, but is rather irregular and scratchy. Nearly all embody easily distinguished animal forms, and the more formal or nearly geometric ones are probably animal derivatives or representations of land, water, or natural phonomena. They are possibly totemic or mythological.

Galax and its Affinities.—One of the most interesting plants of the Southern mountain region is the galax (*Galax aphylla*), which grows in the highlands more or less abundantly from Virginia southward. The slopes of Grandfather Mountain, North Carolina, are carpeted with it for many square miles of almost uninterrupted extent. Besides being an attractive plant at home, its thick, leathery, rounded cordate leaves, deep green or crimson or mixed, according to the season, make it much in demand for decoration, and tons of it in the aggregate are shipped, from places where it grows abundantly, for that purpose. Its affiliations with certain other Alpine and arctic plants are described in a carefully studied paper on the Order Diapensisceæ, published by Margaret Farsman Boynton in the Journal of the National Science Club, Washington. Linnæus found in Lapland a creeping evergreen herb, matting the surface with its stiff, spatulate leaves, and described it in 1737 as *Diapensia lapponica*. Then galax was discovered by Gronovius and given a place by Linnæus—because of its stamens rather than of its natural affiuities—along with Diapensia. Michaux, in the last decade of the eighteenth century, found *Pyxidanthera barbulata*, resembling diapensia, in the pine barrens of New Jersey and North Carolina. More recently other species of diapensia and *Berneuxia* have been found among the Himalayas, and *Schizocodon* of several species in Japan. One of the most remarkable discoveries in the list was that by Michaux in the mountains of North Carolina of a plant which was afterward called *Shortia galacifolia*, from the resemblance of its leaves to those of galax. This plant in a living state was then lost, and when Gray and Torrey looked for it in 1831 in vain, only one preserved specimen of it was known to be extant and that in fruit; and it was not till 1877 that it was collected, rediscovered, in fact, in flower, as Gray has said, "by an herbalist almost absolutely ignorant of botany, who was only informed of his good fortune on sending to a botanist one of the two specimens collected by him." The Shortia, so far as is known, grows only in a very narrow district, and those who know the place are careful not to direct the public to it. Specimens have been collected by a few nurserymen, who cultivate it and have it for sale. The plants of this list are variously classified as among one another by botanists, but are regarded as belonging to a common group. "The real story of their development," says the author of the paper, "can be gathered only in hints from their present distribution, for unfortunately they have neither gallery of ancestral portraits nor recorded geological tree." But their ancestors are supposed to have been pushed down by the glaciers and left where the modern forms are found. Almost anywhere in the boreal flora *Diapensia lapponica* may be found, whether in northern Asia, or Europe, or America, or even on the mountains of Labrador and in the Pyrenees, the Scotch mountains, and our own White Mountains.

The Academy della Crusca.—"For three hundred years," says a correspondent of the London Athenæum, "the learned body, the Academy of la Crusca (the bran), Florence, has been scrupulously sifting the Italian tongue and producing successive editions of its monumental dictionary. Its present seat is in the monastery of St. Mark—Savonarola's cloister—where it occupies the hall behind the great library. When an associate is promoted to full membership, his official reception is still accompanied by the traditional rite. First, he is solemnly conducted to the Cruscan museum, and left to solitary meditation among shovel-backed chairs surmounted by the symbolical sieve and bookcases ingeniously fashioned in the likeness of corn sacks. The walls are covered with the names, crests, and mottoes of former members, who in past times usually assumed fantastic titles descriptive of the academy's labors." Some of these printed inscriptions and comical devices are more or less quaint. Thus, Dr. Giulio Maxi in 1590 took the name of *Il Fiorito*, or the flowery one, with the device of a basket of wheat in bloom and the motto from Petrarch (translation):

"I enjoy the present and hope for better."

In 1641 the Senator Vieri appeared as *Le Svanito*, the evaporated, with an uncorked wine flask, the stopper beside it, and the motto:

"Oh, how I long for the medicine!"

In 1660 the Marquis Malaskini adopted the title of *Il Preservato*, the preserved, the device of olives packed in straw, and the motto from Petrarch:

"Keep the prize green."

In 1764, the Abbot Giuseppe Pelli, surnamed *Il Megliorato*, the improved, took the device of a newly invented sieve for the better sifting of grain, with the Petrarchian motto:

"Follow the few, and not the throng."

In 1770, Signor Domenico Manni assumed the title of *Il Sofferente*, the sufferer, with a straw chair as his device, and a motto from Dante:

"The master said that lying in a feather bed
One would not come to fame—nor under the plowshare."

In due time the new member is escorted to the hall where the academy is assembled, and the chief consul, head of the academy, greets him with a speech, to which he has to make a fitting reply. Historical Italian families are numerously represented on the academy's rolls, and among the foreign members are the names of William Roscoe and Mr. Gladstone.

Aboriginal Superstitions about Bones.—A very interesting archæological site in Mexico, visited by Carl Lumholtz and Aleš Hedlička in the fall of 1896, is near Zacápu, in the State of Michoacan. The region is marked by many stone mounds on or near the edge of the old flow of lava, extending for several miles; and directly above the village stands a large stone fortress, called El Palacio. Excavating near this fortress, Mr. Lumholtz unearthed several skeletons, which had been buried without any order, and accompanied by "remarkably few objects," but some of these were well worthy of study. The most curious things found were some bones, strangely marked with grooves across them, exhibiting a little variety in arrangement, but all similarly executed, and evidently after a carefully devised system. This feature is so far unique in archæology, and its purpose can as yet be only a matter of conjecture. Two ways are proposed by the author of explaining it. The marking may have been an operation undertaken for the purpose of dispatching the dead. Mr. Lumholtz is knowing to a belief among the tribes of Mexico that the dead are troublesome to the survivors for at least one year, and certain ceremonies and feasts in regard to them have to be observed in order to prevent them from doing harm, and to drive them away. The Tarahumares guard their beer against them, and others provide a special altar with food for the dead on it at their rain-making feasts, else the spirits would work some mischief. Among many tribes an offering is made to the dead, before drinking brandy, of a few drops of the liquor. A relation is also supposed to exist between disease and pain and the bones of the deceased person. A whole class of diseases are supposed to have their seat in the bones or the marrow of them. If the disease does not yield to the shaman's efforts, and causes death, the Indians think that the pain will continue after death and vex the ghost, making him malignant and troublesome. Therefore the pain must be conquered, and driven away from the bones and the marrow. Hence the markings may have been made in order to sever all connection between the spirit and his former life, and from the disease that caused his death. The other explanation is that the bones were taken from slain enemies for other purposes than as mere trophies. Personal or bodily relics are supposed to possess some of the qualities of the deceased, and to give power. This view is supported by some observations of Mr. Cushing relative to Zuñi customs; and the author is inclined to favor it rather than the other.

Estrays from Civilization.—A curious study of a community of estrays from civilization who are leading the life of savages is published by M. Zaborowski in the *Revue de l'École d'Anthropologie* and *La Nature.* The settlement is about a mile from Ezy, on the eastern edge of the plateau of Normandy, in a group of caves that were excavated and used as wine cellars when, several hundred years ago, wine culture flourished in the now uncongenial region. Later the spot was a resort for picnics till the old buildings fell into decay, and about fifty years ago it was given up to wanderers. About eighty men, women, and children live there, the adults, though not perhaps really criminals, having been lost to society on account of some offense committed against it. They have no regular means of subsistence, are beneath the tramps in grade, and possess, with one or two exceptions, no articles of property other than what they pick up. Their beds are wooden bunks set upon stones, filled with leaves, and the coverings are wrapping canvas. A "family" of seven persons lived in one of the cellars with only a single bed of this kind. Their kitchen utensils are old tin cans picked out of rubbish heaps, and their stoves are obtained in the same way, or often consist of plates and pieces of iron adjusted so as to make a sort of fireplace. They have a well from which they draw water with some old kettle suspended on a hooked stick, each "family" having its own hook. Their clothes are rags, partly covering portions of the body, and it is not considered necessary that the younger ones should have even these. Their housekeeping and their ideas of neatness are such as might correspond with these conditions. One woman, mother of four children, and the only one that was adequately dressed, was a native of a neighboring village, and had been brought to the cave by her mother when she was eight years old. An old man had been a charge upon the town and was sent to the cave by the *maire* to get rid of him. He had found a woman there and had several children. A woman, still active, who had lived in the caves three years, had children living in Ezy. The complaint, so common in other parts of France, that the natural increase of population has failed, does not apply to the caves. Five or six of the "families" have four or five children. On these children, of whom only the most vigorous survive, "the influence of their debasing misery and of the vices of their parents impresses a common aspect. Their mental condition has fallen shockingly low, and, their physical needs satisfied, they seem to want nothing further. No attraction will induce them to attend school, which is like imprisonment to them. Their mode of life and the marks of degradation in their faces separate them from others. Earnest attempts to develop their intelligence and moral consciousness have been without result."

German School Journeys.—It is very common in Germany, says Miss Dodd, of Owens College, in one of the English educational reports, to find definite teaching taking place outside the school walls—in the gardens attached to the schools, and in the neighboring forests, where the children are instructed in observation of the local forms of plant and animal life. Further, they are often taken on longer expeditions to spend the whole day in the forest or on the mountain with their teachers, who direct them "what to see, and how to see it." More definite and more ambitious than these minor excursions is the school journey, which may last from three days to three weeks. It is usually taken on foot, and is as inexpensive as possible, with plain food and simple accommodation. Each boy carries his own knapsack charged with a change of underclothing, towels, soap, etc., and overcoat or umbrella; while for the common use of the party are distributed clothes brushes and shoe brushes, needles, thread, string, and pins, ointment for rubbing on the feet, a small medicine chest, a compass, a field glass, a pocket microscope, a barometer, and a tape measure. The district visited is chosen on account of its historical associations or the geographical illustrations it furnishes, or the richness and variety of plant life to be studied. Constant pauses are made to afford opportunities for the examination of features inviting study; and the scenes visited are often closely connected with the subjects included in the year's work of the school. In a journey, of which Miss Dodd was a member, preparations were begun three months beforehand, with the collection of subscriptions, drawing of road maps, and special lessons. The fifty boys from ten to fifteen years old, marched off in groups of four, assorting themselves according to their affinities for companionship, with advance and rear guards; the regions passed through were explored for what might be found in them; the roads were marked and identified, mountains and rivers were named, and the courses of streams determined; and at each place of considerable interest its characteristic features and associations of Nature, art, and history were discussed and studied.

The Huichol Indians of Jalisco.—The Huichol Indians of Mexico, the subject of a study by Carl Lumholtz, four thousand people living in the mountains of northern Jalisco, have a tradition that they originated in the south, got lost underneath the earth, and came forward again in the east, in the country of the *Kikuli*, near San Luis Potosi. Franciscan missionaries converted them nominally to Christianity, but there are now no priests in their country, and there is probably no tribe in Mexico where the ancient beliefs have been so well maintained as with them. Their exterior conditions have been somewhat altered by the introduction of cattle and sheep, and cattle are now the favorite animals for sacrifice at the feasts for making rain during the dry season. The people are healthy, very emotional, easily moved to laughter or tears, imaginative and excitable. Young people show affection in public, kissing or caressing one another. They are kind-hearted and not inhospitable to those who can gain their confidence, but have the reputation of being wanting in regard for truth. They live mostly in circular houses made from loose stones, or stones and mud, and covered with thatched roofs. Their temples, devoted to various gods, are of similar shape, but much larger, with the entrances toward sunrise. Outside of the door is an open space surrounded by small rectangular god-houses, with gabled and thatched roofs. The god-houses are also frequently found in the forests, and are sometimes circular. There are nineteen temples in the country which are frequented at the times of the feasts, when the officials and their families camp in the small god-houses. Idols are not kept in the temples, but are hidden in caves or in special buildings. There are a great many sacred caves devoted to various gods, and generally containing some pool or spring that gives them sanctity, and the water of which is supposed to have salutary virtues. Much religious importance is attached to the *Kikuli* cactus, which produces an exhilarating effect on the system. Ceremonial arrows are inseparably connected with their life, the arrow representing the Indian himself in his prayers to the gods. They have other interesting ceremonies and ceremonial objects, and a curious system of distilling, which Mr. Lumholtz describes at length.

Herrings at Dinner.—The food of the herring consists of small organisms, often of microscopic dimensions. It is entirely animal, and in Europe, according to those who have investigated the matter, it consists of copepods, schizopods (shrimplike forms), amphipods (sand fleas and their allies), the embryos of gasteropods and lamellibranchia, and young fishes, often of its own kind. In the examination of about fifteen hundred specimens of herring at Eastport, Maine, and vicinity, in the summer and fall of 1893, Mr.

H. F. Moore, of the Fish Commission, found only two kinds of food—copepods or "red seed," which appeared to constitute the sole food of the small herrings, and shrimps the principal food of the larger ones. In many cases the stomachs of the fish were densely gorged with these shrimps, which are extremely abundant in the waters of the vicinity. Excepting the eyes and phosphorescent spots beneath, which are bright red, the bodies of the crustaceans are almost transparent, yet such is the density of the schools in which they congregate that a distinctly reddish tinge is often imparted to the water. They are very active, and frequently avoid the rush of the fish by vigorous strokes of their powerful caudal paddles, which throw them several inches above the surface. To capture them requires some address on the part of the herring, and the fish likewise frequently throw themselves almost clear of the surface. When feeding upon copepods the movements of the herrings are less impetuous. They swim open-mouthed, often with their snouts at the surface, crossing and recrossing on their tracks, and evidently straining out the minute crustaceans by means of their branchial sieves. After they have passed the stage known as "brit," the herrings appear to feed principally at night, or if they do so to any considerable extent during bright daylight it is at such a depth that they escape observation. At night it is often possible to note the movements of the fish at a depth of several fathoms, and at such times Mr. Moore has seen them swimming back and forth, "apparently screening the water, their every movement traced by a phosphorescent gleam, evoked perhaps from the very organisms which they were consuming." The herrings evidently follow their prey by night, and the fact that the shrimps possess phosphorescent spots may explain the apparent ability of the fish to catch them then.

MINOR PARAGRAPHS.

The phosphorescence, which is so beautiful a characteristic of certain forms of animal life in the sea, has been the cause of much speculation among the fishermen and scientists; none of the proposed theories have been entirely satisfactory. It is now stated, however, that an adequate and provable cause has been discovered in a so-called species of photo-bacteria; by means of this germ it is stated that sea water, containing nutrient media, can be inoculated and rendered phosphorescent; that newly caught herrings with the sea water still fresh can be rendered phosphorescent by a treatment which favors the growth of the photo-bacteria. Oxygen is an essential to their growth.

Personal equation was defined by Prof. T. H. Safford, in a paper read at the American Association, as in reality the time it takes to think; and as that time is different in different persons, observations are liable to be affected by it unless correct allowance is made for it in the case of each one. It has been a subject of discussion since the end of the last century. The Astronomer Royal of England discharged a good assistant in 1795, because he was liable to observe stars more than half a second too late. Bond, several years afterward, took the subject up and found that astronomers were liable to vary a little in their observations; some to anticipate the time by a trifle, and others falling a little behind. The subject has since been studied by Professor Wundt. In the days when the eye-and-ear method of observation prevailed, the astronomer had both to watch his object and to keep note of the time; with the introduction of the chronograph, the errors resulting from this necessity are in part obviated. But error enough still exists to be troublesome.

The Educational Extension Work in Agriculture of Cornell University Experiment Station is carried on by the publication and distribution of leaflets, visitation of teachers' institutes, and other means that may bring the station in contact with the people. The results of the work have been generally satisfactory. Eight leaflets, on such subjects as How a Squash Plant gets out of the Seed, A Children's Garden, etc., were published last year in from two to six editions, and still meet a lively demand. Thirty thousand teachers were enrolled on the lists as receiving leaflets, or as students of methods of presenting Nature study to their pupils, sixteen thousand school children were receiving leaflets suitable to them, and twenty-five hundred young farmers were enrolled in the Agricultural Reading Course. Much interest seems to have been shown by farmers in sugar-beet culture, in investigations of which more than three hundred of them are co-operating with the station, and two hundred in experiments with fertilizers.

NOTES.

An important feature in the evolution of trade journalism is pointed out in the presidential address of E. C. Brown, of the American Trade Press Association, in the establishment of small trade journals, covering limited fields. Such industries as brickmaking, stenography, advertising, acetylene, hospital practice, etc., are ably represented by their respective trade journals; and this tendency is promoted by the complementary one of the trades, in their centralization and concentration, compelling even journals in the same business to make their field distinct and restricted. The public demands specific information, not for the purpose of catering to a passing interest, but for its application directly in the conduct of business or the formation of a policy; and those trade journals succeed best which supply accurate information of value to their readers.

The ascent of Mont Blanc was accomplished between June 21st and September 16th by one hundred and nineteen persons, eleven of whom were women. By nationality the climbers included forty-four Frenchmen and eleven Frenchwomen, fifteen Englishmen and one Englishwoman, and fifteen Swiss, with Germans, Americans, Belgians, Hollanders, Irish, and Russians. A Belgian lady and a Dutch lady were of this company. A Frenchwoman, seventy-five years old, was one of the party that reached the summit on one of the last days in September.

Mr. Horace Brown, whose interesting researches on the enzymes have attracted much attention during the past few years, has recently announced the results of some important experiments on the vitality of seeds. He found that certain seeds subjected to the very low temperature of evaporating liquid air, about — 192 C., for one hundred and ten consecutive hours, retained perfectly their power of germinating.

The report made by Prof. W. A. Herdman to the British Association concerning the liability to disease through oysters recognizes the possibility of contamination through the proximity of the beds to sewage water, and recommends steps to be taken, through either legislative control or association, to induce the oyster trade to remove any possible suspicion of contamination of the beds; provision for the inspection of foreign oysters or their subjection to a quarantine by deposition for a stated period in British waters, as already takes place in many instances; and the periodical inspection of the grounds from which mussels, cockles, and periwinkles are gathered.

As the result of long-continued observations of annual temperatures the appearance of the earliest leaves, and the return of birds of passage, M. Camille Flammarion has published the conclusions that the maximum temperatures correspond with abundant sun spots and the least humidity, and the minimum temperatures with scarcity of sun spots and great humidity; and that sparrows begin to sit when horse-chestnuts, lilacs, and peonies begin to bloom, and the young are hatched about two days after these plants are in full inflorescence. M. Flammarion also believes that the temperatures of March and April indicate those of the entire year.

Little steel capsules containing a small quantity of liquefied carbonic acid are made, *La Nature* says, at Zurich, Switzerland. One of them is placed in the neck of a bottle of water which is provided with a faucet and the capsule is pricked. The carbonic acid escapes and charges the water, and a bottle of soda water is the result. The capsules are cheap and convenient, and are very popular in Switzerland and Germany.

It is proposed to erect a memorial to James Clerk Maxwell in the parish church of Corsock, of which he was a trustee and elder. Subscriptions may be sent to the Rev. George Stimock, The Manse, Corsock by Dalbeattie, N. B.

Our obituary list includes among men well known in science the names of Edward Dunkin, an English practical astronomer, for fifty years an assistant and part of the time chief assistant at the Royal Observatory, Greenwich, a contributor of many paper on practical astronomy, aged seventy-seven years; H. Vogel, professor of photography, photo-chemistry, and spectroscopy in the Technical High School, Berlin, author of The Chemistry of Light and Photography, in the International Scientific Series, in his sixty-fifth year; Alexandre Pillet, curator of the Musée Dupuytre, Paris, and well known for his contributions on morbid anatomy, at Paris, November 2d, aged eighty-eight years; George T. Allmann, formerly professor of botany in Dublin and of natural history in Edinburgh, who described the hydroids collected by the Challenger Expedition, and was author of a number of monographs on the invertebrates, aged eighty-six; Thomas Sanderson Bulmer, investigator in American archæology and ethnography, and contributor to Pilling's Bibliographies of American Languages, at Sierra Blanca, Texas, October 5th; and Dr. Ewald Geissler, professor of chemistry at the veterinary school of Dresden, aged fifty years.

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THE EVOLUTION OF COLONIES.

By JAMES COLLIER.

VII.—SOCIAL EVOLUTION.

PERHAPS there is no civilized institution to which man has accommodated himself with so ill a grace as monogamy. Hardly a perversion of it has ever existed but may still be found. Polygamy is widely spread in the most advanced communities; temporary polyandrous *ménages à trois* are known to exist elsewhere than among the Nairs and Tibetans and *ancient* Britons; the matriarchate in one shape or another may be detected well outside the sixty peoples among whom Mr. Tylor has discovered it; and marriage by free choice is far from having superseded marriage by capture or by purchase. It is the less surprising that abnormal or ancient forms of the union should have been revived in colonies. In this relationship, as in most others, the colonist, like the sperm cell after its junction with the germ cell, sinks at once to a lower level, and the race has to begin life over again. The fall is inevitable. The earliest immigrants are all of them men. Everywhere finding indigenes in the newly settled country, they can usually count on the complaisance or the submissiveness of the tribesmen. Native women have a strange fascination for civilized men, even for those who have been intimate with the European aristocracies and have belonged to them. Adventurous Castins might find their account in a relationship that was in perfect keeping with the wild life they led. It is more strange that, enslaved by an appetite which sometimes rose to a collective if seldom to a personal passion, educated men, with a scientific or a public career flung open to them at their option, able men who have written the best books about the races they knew only too well, men of great position whose heroic deeds and winning manners made them adored by women of their own race, should have spoiled their prime, or inextricably entangled themselves, or wrecked their own roof-tree and incurred lifelong desertion by the wife of their youth. The bluest blood of Spain was not contaminated by an alliance with the Incas, but just ten years ago the direct line of an ancient English earldom was extinguished among the Kaffirs. The truth seems to be that while a woman will not as a rule accept a man who is her inferior in rank or refinement, a man easily contents himself for the time with almost any female. The Bantu woman and the Australian *zubra* are not alluring, but they have never lacked suitors. Colonial women shrink (or profess to shrink) from the Chinaman; all colors—black, brown, red, and yellow—seem to be alike to the undiscriminating male appetite. Yet it has its preferences. The high official who stands unmoved before the cloudy attractions of the Zulu, surrenders at discretion to the soft-voiced, dark-eyed, plump-limbed daughters of Maoriland. In the last case a perverse theory (of the future amalgamation of the races) may have been "the light that led astray"; it certainly was used to justify their acts to the consciences of the doers. Romance had its share: Browning's Waring (who was premier as well as poet) threw a poetic glamour over the miscegenation, as another minister found in the race the Ossianesque attributes of his own Highlanders. It sometimes, even now, rises into passion: the colonial schoolmaster who marries a native girl will declare that his is a love match. But the chief reason at all times was "the custom of the country." "It was the regular thing," remarked an old legislator, looking ruefully back on his past. Nor is it to be harshly censured. Corresponding to the Roman slave-concubinage which Cato Major did not disdain to practice, it repeated a stage in the history of the mother country when the invading Angles allied themselves (as anthropology abundantly proves) with the native Britons. While making a kind of atonement to the indigenes, it was a solatium to the pioneer colonists for a life of hardship and privation.

A higher grade was the concubinage of convictism, which was with women of the same race and was capable of rising into normal marriage. In the early days of New South Wales and Van Diemen's Land it seems to have been almost universal, and it lasted for many years. Not one in ten of the officials lived with his legally married wife. In the latter colony it was suppressed by the governor, who ordered them to marry the women by whom they had families. In the former, if Dr. Lang's account of his exertions is accepted, it was put down by the exposure of guilty parties. It was accompanied by other features of a low social state. The public and private sale of wives was not infrequent. The colonial equivalent for a wife, in the currency of those days, was sometimes four gallons of rum, or five pounds sterling and a gallon, or twenty sheep and a gallon; one woman was sold for fifty sheep.

Around gold and silver mining encampments nondescript relationships of a slightly higher order arise. They are with free women, though the women are apt to be of the same class as Bret Harte's Duchess of Poker Flat, answering to the Doll Tearsheets of hardly more civilized communities. They often issue in marriage. In mining townships, and even in colonial towns, professional men are to be found married to unpresentable women.

In colonies of regular foundation normal marriages are contracted under difficulties. Few women at first go out, the emigrants intending to return when they have made their fortune. Women have accordingly to be sent. In the seventeenth century a number of girls of good repute were persuaded to emigrate to Virginia, a subscription being raised to defray the cost. In the following century wives were sent to settlers in French Louisiana on the same plan. To French Canada women were dispatched by shiploads. They were selected (according to Parkman) as butchers choose cattle: the plumpest were preferred, because they could stand the winter best and would stay at home. In Virginia women were offered for sale to eager colonists, who willingly paid one hundred pounds of tobacco for one, or as much as one hundred and fifty pounds for a very pretty girl; a debt incurred for the purchase of a wife being considered a debt of honor. In the early days of Canterbury, New Zealand, when a consignment of servant girls arrived, young farmers would ride over the Port hills and carry them off, though in the style rather of young Lochinvar than of the Sabine rape. Settlers have often requested the agent general for the colony or the mayor of their native town to send them out a wife. Wives so easily acquired are apt to be lightly parted with, and within the last few years, in colonial villages, amicable exchanges have been effected—one woman going with her children to the house of another man, whose wife and children made a reciprocal migration. Facts such as these (which might readily be multiplied) show how easily so-called civilized man sloughs off the conventions of ages and sinks to a primitive level. They soon disappear, however, and social colonial conditions rapidly assimilate themselves to those of the mother country. In most young colonies marriage is universal and it is early. After a few days' acquaintance couples rashly engage themselves, in utter ignorance of one another's character or of their own, and a precipitate marriage follows, with such results as might be expected. Statistics show that the age of marriage on the part of women is steadily rising. In the early days of each colony a girl was deemed *passée* if she did not get married before she was twenty-one. In the decade that ended the first century of New South Wales the proportion of married women under that age fell from 28.17 to 23.55 per cent; in less prosperous Victoria, after only half a century, it fell from 21 to 17.4; in New Zealand there was a big drop from 29.4 to 19.7. The proportion of married women under twenty-five has also seriously declined. The decrease is noticeably correspondent with the increased number of young women who are gaining their own livelihood—largely as teachers and typewriters. On these lines the colonies are following the lead of the mother country. Long engagements, followed by late marriages with fewer children, take the place of short engagements with hasty marriages and larger families. Female celibacy is no longer dishonorable, and women are beginning to understand that they may be far happier single and self-supporting. The quality of marriage improves with its rarity. When an Australian M. A. marries an M. A., or the most brilliant of New Zealand professors marries one of his most distinguished students, we feel, as when a Dilke marries a Pattison, that the ideal of the union has been realized.

The growth of the colonial house follows the development of the family and repeats the history of the race. The immigrant procures his abode, as he afterward buys his clothes, ready made. The ancient troglodyte lives to-day in the Derbyshire cave dweller; the original Romanist settlers of Maryland were driven to take refuge in cave houses in Virginia; and the New Zealand hermit, like "great Pæan's son" at Lemnos, "weeps o'er his wound" of the heart in a cave by the resounding sea. Where they can not be found ready dug they can be excavated, as they were by some early Pennsylvania colonists. Others in Virginia, New York, and New England found it easier to dig holes in the ground, thus imitating the Germans of Tacitus, whose winter residences are also repeated in those basements which form the wholesome abode of the London domestic servant. The wattle-and-daub house of the Anglo-Saxon villager has been everywhere reproduced in the colonies, and may still be abundantly found.

If the occupation of caves and the burrowing of holes suggests man's distant affinity to the carnivora and lower quadrupeds, his simian origin is confirmed by the use he makes of the tree. In the infant city of Philadelphia there were "few mansions but hollow trees." A rude form of tent is the next stage, the canvas consisting (as may still be seen among the poorer campers-out) of clothes or rags. Then, as in the early days of Sydney, the tents were covered in with bushes and thatched over. Next (as may to-day be observed in the neighborhood of Coolgardie) a framework of branches is employed to support the canvas, and the tent is converted into a cabin.

A stride toward the house is taken when the branches are replaced by a regular woodwork, with doors and windows; the envelope being still sometimes canvas, which is soon replaced by corrugated iron. The Brazilian country house where Darwin lodged sixty years ago was built of upright posts with interwoven boughs. Another line of development starts from the trunk of the tree. The early American colonists made bark wigwams. The Australian pastoralist "erected a temporary house, generally of large sheets of bark, in the first instance." In countries where the winter is more severe or the bark less substantial, the backwoodsman builds, as the early colonist built, a rude cabin of round logs. Then the logs are hewn, or they are split or sawn into planks, and built into the weatherboard houses still common in the rural parts of Australia, and general even in New Zealand towns. In their earliest stages they are still without a floor and are roofed with thatch or shingle. Towns often thus remain like early Sydney, "a mere assemblage of paltry erections intermediate between the hut and the house." The architecture is of the simplest. A "butt" and a "ben," with a "lean-to," form the prevailing type. As the family grows or its wealth increases, new portions are added, till many colonial houses look for all the world as if they had "come out in penny numbers." Even with a few stately structures—luxurious mansions, extensive government offices, Gothic parliamentary buildings—a wooden city has an indefinable meanness of appearance. It is improved out of existence by the dread agency of fire. Like Charles's London, New Orleans and many another colonial town have thus had an Augustan renewal. Houses are now built of brick, stone, or concrete; tile, slate, and iron replaced thatch and shingle; two stories were ventured on; chimneys were smaller but safer. They became susceptible of architecture: Spanish features were introduced into those of New Orleans; the more northern colonies copied the English country house, with modifications to suit the hotter or colder climate; and in New South Wales a taste for mansion-building came into vogue along with splendid equipages, liveried servants, and pedigrees. Such houses were at first arranged in all degrees of irregularity and confusion. The street is a modern invention. The cows returning from pasture laid out Boston, and the bullock teams climbing up from the harbor charted Sydney. Towns in manufactured colonies, as Savannah, Augusta, most South American cities, Christchurch and Invercargill in New Zealand, were planned before settlement and have their streets at right angles.

A hundred years ago Talleyrand, exiled in the United States, described the journey from one of these cities to the interior as successively exhibiting all past stages of the human habitation from the mansion to the tent, and just a century later one of Talleyrand's countrymen, M. Pierre Leroy-Beaulieu, traveling in the reverse direction, from "the bush" to Coolgardie, witnessed the gradual transformation of the tent into the two-storied hotel. A great part of the history of the race in the matter of habitations is thus museumed in the space of a few miles.

If the temple rises out of the tomb, is modeled on that, and remains to the last pre-eminently a place of sacrifice, the church is an enlarged dwelling house. It is the house of the god, as the fetichist called it—the house of God, as we still reverently call it; and in Romanist countries to this day it is in a manner the abode of two divine personages, who figure as dizened and painted dolls that are named respectively God and the Mother of God! Both lines of development are rapidly recapitulated in colonies. The temple appears as the cathedral, which has modest beginnings, but gradually assumes the architecture and proportions of Gothic cathedrals, losing relation to the primary wants of the worshipers—comfort and audibility—ministering mainly to their higher needs, and if used for preaching at all, reserved for such occasional and sensational pulpit oratory as that of Dominican monks like Lacordaire at Notre Dame in Paris, or of a Protestant Dominican like the late Canon Liddon at St. Paul's in London. The church, chapel, or meeting house may be found in colonial villages in its most rudimentary form, scarcely distinguishable in style from a dwelling house. According to the sect it belongs to, it develops in one of two opposite directions. The age of cathedrals is past, even in Roman Catholic countries, but the tendency of Anglican and allied churches is to simulate the old cathedral; high ritualistic sections mimic the gorgeous Madeleine. The more liberal denominations, on the other hand, develop downward; the colonial Baptist tabernacle is on the lines of Spurgeon's great building at Newington, but the ancient pulpit is widened into a platform and the seats slope upward as in a concert hall; it is a mere auditorium, in which the preacher is all. The development in this direction finds its extreme in the secularist hall, which is a mere concert room, with a piano in place of an organ. The ceremonial development is on the same lines—toward the gradual adoption of ancient rites by the older churches, toward more freedom in the younger sects. Many a colonial clergyman has wrecked himself or his congregation through too much ritualism; a few have injured themselves through an excess of liberalism.

A parallel evolution takes place in church government. Where an organized settlement is made on political principles, congregations carry their minister with them, or rather the ministers carry their congregations. Where the colony is normally founded and grows up as the mother country grew, the first ministers, like the first preachers of Christianity itself, are often laymen. In an interior county of Virginia Morris read every Lord's day to his neighbors from the writings of Luther and Bunyan, and a meeting house was at length built for him; it is a typical instance of the beginnings of most churches. The part of laymen remains long prominent in colonies. The Anglican lay reader is everywhere a feature of colonial church life. In the more flexible churches a storekeeper or retired sea captain will read Spurgeon's sermons or preach excellent sermons of his own in an Otago village or the Australian bush. Where missionaries have been sent out to convert the heathen in a country afterward colonized, many of them remain as ministers, as did Augustin and his monks in England. The Presbyterian catechist likewise becomes a settled minister. Others arrive. Men of independent character, like Dr. Lang, of Sydney, resolve not to wait for any dead man's shoes in the kirk, but sail beyond the seas to colonies where there is no minister of their own denomination. Heretics, incompatibles, men who have failed, men whose health has given way, emigrate in increasing numbers. Still, the supply is long deficient. Clergymen were scarce in New York. A bounty was offered to immigrants in Virginia. Six years after the establishment of the Church of England in North Carolina there was only one clergyman in the country. The few there are repeat the history of the first Christian bishops and the early English monks in serving a circuit of two, three, or more churches. The state comes to the rescue by providing for their support. In England contributions were at first voluntary; by the eighth century tithes were levied, folk-land was granted, and private endowments were made. Just so was the Church of England established and endowed in New York, Virginia, and North Carolina; in Maryland a poll tax of forty pounds of tobacco was levied for its support. In Connecticut and Massachusetts a church was set up in each parish on Congregationalist principles by a vote of the people, who elected the minister and voted his salary. So uncertain was the tenure that in several States even the Anglican minister was hired from year to year; and quite lately an Anglican church in a British colony engaged its incumbent, as it might have engaged its organist, for a term. In 1791 the Church of England in Canada was partially established, and its clergy endowed with grants of land. The Australasian colonies have pursued a very various policy. By the Constitution Act of 1791 one seventh of the ungranted lands in New South Wales was set apart for the support of a Protestant clergy. An attempt to endow the Anglican Church in South Australia in the early forties was defeated by a radical governor. A recrudescence of the ecclesiastical principle permitted the church settlements of Otago and Canterbury in New Zealand to appropriate a portion of the funds derived from the sale of lands for the endowment of the Presbyterian and Anglican churches respectively. So far the colonies followed, latterly with halting steps, the history of the mother country. As in political, so in ecclesiastical government, they have anticipated that history. The American state churches did not survive the Revolution. In Canada the Presbyterians and other sects successfully asserted their claims to a share in the church endowments, which between 1840 and 1853 were distributed among the municipalities, all semblance of a connection between church and state being thus destroyed. New South Wales passed through a period of religious equality with concurrent endowment of the four most numerous denominations, and a long struggle against the principle of establishment was ended in 1879, when the reserves were devoted to the purposes of education. The practice of confiscating for the church a portion of the proceeds of the land sales was gradually dropped in Otago and Canterbury, probably more for commercial reasons than in consequence of the opposition of the democratic governor aforesaid, who spoked the wheel of the South Australians. Yielding to Nonconformist pressure, the liberal Government in 1869 enforced the principle of religious equality throughout the crown colonies, which were thus, willingly or not, made to follow the lead of the movement in Ireland. The internal organization of the colonial church is also anticipative. Fifty-two years ago Sir George Grey bestowed on the Anglican Church in New Zealand, then governed by him, a constitution modeled on that of the corresponding church in the United States, as the political constitution he drafted for the colony was modeled on the Constitution of the United States; and it has been imitated in other Australasian colonies, which have thus declared themselves independent of the mother church, while the colony is still politically dependent on the mother country. In yet another point the daughters have outstripped the parent. Three Presbyterian denominations still fissure the old home of Presbyterianism; only two have ever existed in the colonies, and for thirty years these two have been one. The four chief Methodist sects in Australia are also said to be on the point of amalgamating.

The development of doctrine runs a fourth parallel to those of buildings, cult, and organization, and in a brief space it recapitulates a long history. In early colonial communities religious dogma is found in a state of "albuminous simplicity." "A healthy man," says Thoreau, "with steady employment, as wood-chopping at fifty cents a cord, and a camp in the woods, will not be a good subject for Christianity." Nor will a bush-faller, at twenty-five shillings the acre. Distant from a church and a minister, he gets out of the way of attending the rare services brought within his reach, and forgets the religion in which he was nurtured. It does not mingle with his life. He is usually married at a registrar's. His children are unbaptized. His parents die unshriven. The dull crises of his mean existence come and go, and religion stands dumb before them. The inner spiritual realities fade from his view as their outward symbols disappear, and bit by bit the whole theological vesture woven by nineteen Christian centuries drops off him like Rip Van Winkle's rotten garments when he woke from his long sleep. In the matter of religion, as in almost all else, the colonist has to begin life again poor.

As population grows and people come nearer to one another, two things happen. The churches push their skirmishers into the interior, plant stations, and have regular services. Gradually the old doctrines strike root in the new soil, and at length a creed answering to Evangelicalism is commonly held, thus repeating the first stage in the history of Christianity in Asia as in England. On the other hand, many of those whom neglect had softened into indifference or hardened into contempt assume a more decided attitude. With the spirit of independence which colonial life so readily begets, and stimulated by the skeptical literature of the day, they take ground against the renascent religion. Secularism, which denies what Evangelicalism affirms and is on a level with that, is born. It organizes itself, has halls and Sunday meetings, catechisms and children's teaching, newspapers, and a propaganda. For a while it is triumphant, openly contemptuous of the current religious mythology, and menacing toward its exponents. The Secularist leaders make their way to the bench and the legislature, the cabinet and the premiership. It is here the hitch arises. Some (by no means all) of these leaders are found to prefer power to principle, and prudently let their secularism go by the board when a wave of popular odium threatens to swamp the ship. Financial distress spreads. The movement loses *éclat*. As Bradlaugh's Hall of Science in London has been sold to the Salvation Army, the Freethought Hall in Sydney has been purchased by the Methodists, and in other colonial towns the cause has collapsed. But it always remains, whether patent or latent, as a needed counterpoise to the crudities of Evangelicalism, and it is the core of that increasing mass of religious indifferentism which strikes those who have been brought up in the old country. Statistics are said to prove that Australia is more addicted to church-going than England. If they prove any such thing, then statistics (as Mr. Bumble irreverently said of the British Constitution) are hasses and hidiots. You may sit down on any Sunday morning at a colonial table with a dozen highly respectable persons of both sexes and all ages, not one of whom has any thought of going to church that day. Such an experience would be impossible in England. The mistake has arisen from comparing England as a whole, which has classes below the line of church-going or indeed of civilization, with Australia as a whole, where such classes hardly exist. Compare Australia in this respect with the English middle classes, and the fallacy will be manifest.

When a colony has hived off from the parent state at a time of religious excitement, and especially when it has religion for its *raison d'être*, it starts fully equipped on lines of its own, the earlier naturalistic stages being dropped. English theology and Puritan religion emigrated to North America in the seventeenth century, and there for two centuries they for the most part remained. Ever since, in New England and the States of the middle belt, religion has played the same high part as it did in old England under Oliver. There has, therefore, been a theological development in the United States to which, till fifty years ago, there was no antecedent parallel in the mother country. While it has produced no theologian or pulpit orator of the first rank—no Calvin, but only Jonathan Edwards; no Bossuet or Chalmers, but only Channing and Beecher—its theological literature compares favorably with that of England during the same period, and its preachers are acknowledged to be the best in Christendom. States and colonies that have grown up more normally get at length on the same lines, and as they put on civilization the tendency is to adopt ever more of the dogmatic system long inseparable from it. By a well-understood sociological law it generates its contradictory and corrective, and there springs up a higher type of denial than secularism—what Huxley felicitously named Agnosticism—the position of those who know nothing about the matters which theological dogma defines, not the position of those who say that nothing can be known. As the Evangelical develops into the High Churchman and he into the Catholic, the Secularist refines into the Agnostic and rarefies into the Unknowabilist.

The literature of colonies is at first theological, as the literature of all countries is at first hieratic; the priest alone can write. But it is long before the stage of original production is reached, and books have to be imported before they can be written. The daughter must go to school with the mother, who supplies her with hornbooks. The continuity of the spiritual germ-plasm is insured by the transmission of books. Rome was thus initiated by Greece in every theoretical branch of knowledge. Rome thus educated early Europe. Chests of manuscripts from Thessalonica, Byzantium, and Crete were the precursors of the Renaissance. Books brought by Benedict to England formed the first English library. So is it long with all new countries. To this day the book circulation of the United States is largely English; in contemporary colonies it is overwhelmingly English, almost wholly Spanish, exclusively French or Dutch. The second stage also repeats the literary history of the mother countries. Colonial literature is a prolongation of the parental literature and is at first commentative and imitative of that. In a school at Canterbury founded by two foreign monks English written literature took its birth. The literature of mediæval Europe was a continuation of Roman literature. This stage may last long. Seventy or eighty years after the Declaration of Independence the literature of New England was still English literature of a subtler strain—perhaps lacking the strength of the old home-brew, but with a finer flavor. Naturally, in far younger Australia even popular poetry is still imitative—the hand is that of Gordon or of Kendall, but the voice is Swinburne's. The beginnings of a truly national literature are humble. They are never scholastic, but always popular. As chap-books, ballads, and songs were the sources of the æsthetic literature of modern Europe, the beginnings of general literature in the United States have been traced to the old almanacs which, besides medical recipes and advice to the farmer, contained some of the best productions of American authors. It is further evidence of the popular origin of native literature that some of its early specimens are works of humor. The most distinctive work of early Canadian and American authors is humorous, from Sam Slick to ——; but it would be rash to say *who* is the last avatar of the genius of humor. If an alien may say so without offense, Walt Whitman's poems, with their profound intuitions and artless metre, seem to be the start of a new æsthetic, and recall ancient Beowulf. Australian literature, after a much shorter apprenticeship, has lately, in both fiction and verse, again of a popular character, made a new departure that is instinct with life and grace and full of promise.

Literature and art have no independent value, but are merely the phonographic record of mental states, and would practically cease to exist (as they did during the middle ages) if these disappeared. The grand achievement of new, as of old, countries is man-making, and every colony creates a new variety. The chief agent is natural selection, of which the seamy side appears in vicissitudes of fortune. Here again the law prevails. These recapitulate those vicissitudes in early European societies which make picturesque the pages of Gregory of Tours. There are the same sudden rises, giddy prosperities, and inevitable falls. In the simple communities of ancient Greece the distance between antecedent and consequent was short, and the course of causation plain. Hence in myth and legend, in early historians like Herodotus, early poets like Pindar, early dramatists like Æschylus, we find a deep sense of the fateful working of the laws of life. The history of colonies is a sermon on the same text. Goodness is speedily rewarded; retribution no longer limps *claudo pede*, like Vulcan, but flies like Mercury with winged feet. In Europe a high-handed wrongdoer like Napoleon may pursue his career unchecked for fifteen years, or a high-handed rightdoer like Bismarck for five-and-twenty years; a would-be colonial Bismarck or Napoleon is commonly laid by the heels in the short duration of a colonial parliament. The vision of providential government, or the reign of law, in old countries is hard, because its course is long and intricate; in a colony it is so comparatively simple that all may understand it and find it (as Carlyle found it) "worthy of horror and worship." From witnessing the ending of a world Augustine constructed a theodicy, and so justified the ways of God to man. We may discover in the beginnings of a world materials for a cosmodicy which shall exhibit the self-operating justice inherent in the laws of the universe.

POLITICS AS A FORM OF CIVIL WAR.

By FRANKLIN SMITH.

WHY is it that, in spite of exhortation and execration, the disinclination of people in all the great democracies of the world to take part in politics is becoming greater and greater? Why is it that persons of fine character, scholarly tastes, and noble aims, in particular, seek in other ways than association and co-operation with politicians to better the lot of their fellows? Why is it, finally, that with the enormous extension of political rights and privileges during the past fifty years, there has occurred a social, political, and industrial degeneration that fills with alarm the thoughtful minds of all countries? Aside from the demoralization due to the destructive wars fought since the Crimean, the answer to these questions is to be found in the fact that at bottom politics is a form of civil war, that politicians are a species of *condottieri*, and that to both may be traced all the ethics and evils of a state of chronic war itself. In the light of this truth, never so glaring as at present in the United States, the peril to civilization is divested of mystery; it is the peril that always flows from anarchy, and the refusal of enlightened men to-day to engage in politics is as natural as the refusal of enlightened men in other days to become brigands.

The analogy between war and politics is not new. The very language in common use implies it. When people speak of "leaders," "rank and file," "party loyalty," "campaigns," "spoils of victory," etc., which figure so conspicuously and incessantly in political discussion, there is only a fit appropriation of the militant terms invented by one set of fighters to describe with vividness and precision the conduct of another set. What is new about the matter is the failure of thoughtful persons to perceive and to act upon their perception that in politics, as in war, vast economic, social, and political evils are involved. To be sure, lives are not often sacrificed, as in a battle, nor property destroyed, as in a siege or an invasion. But even here the analogy is not imperfect. Political riots have occurred that have brought out as completely as any struggle over a redoubt or barricade the savage traits of human nature. People were maimed and killed, and houses wrecked and burned. Especially was that the case in this country during the antislavery struggle and the period of reconstruction. Even in these days of more calm, political contests as fatal as the Ross-Shea *émeute* in Troy are reported from time to time. Owing, however, to the advance in civilization since the sack of Antwerp and the siege of Saragossa, the devastation wrought by political warfare has assumed forms less deplorable. But in the long run they will be found to be just as fatal to everything that constitutes civilization, and just as productive of everything that constitutes barbarism. "Lawless ruffianism," says Carl Schurz, pointing out in his Life of Henry Clay the demoralizing effects of the fierce political struggles during Jackson's administrations, "has perhaps never been so rampant in this country as in those days. 'Many of the people of the United States are out of joint,' wrote Niles in August, 1835. 'A spirit of riot and a disposition to "take the law in their own hand" prevails in every quarter.' Mobs, riots, burnings, lynchings, shootings, tarrings, duels, and all sorts of violent excesses, perpetrated by all sorts of persons upon all sorts of occasions, seemed to be the order of the day. . . . Alarmingly great was the number of people who appeared to believe that they had the right to put down by force and violence all who displeased them by act or speech or belief in politics, or religion, or business, or in social life." It is only familiarity with such fruits of violent political activity, only a vision impaired by preconceived notions of the nature of politics, that blinds the public to their existence.

To see why politics must be regarded as a form of civil war rather than as a method of business, as a system of spoliation rather than as a science to be studied in the public schools,* it is but needful to grasp the fundamental purpose of government as generally understood. It is not too much to say that nothing in sociology is regarded as more indicative of an unsound mind or of a mean and self-

* An absurd suggestion made by the State Superintendent of New York.

ish disposition than the conception of government as a power designed to prevent aggression at home and abroad. Such a conception has been contemptuously called "the police conception." "Who would ever fight or die for a policeman?" cried an opponent of it, trying to reduce an adversary to ignominious silence. It was not sufficient to reply with the counter question, "Who would not die for justice?" and thus expose the fallacy of the crushing interrogation. "No one," came the retort, "could care for a country that only protected him against swindlers, robbers, and murderers. To merit his allegiance and to fire his devotion, she must do more than that; she must help to make his life easier, pleasanter, and nobler." Accordingly, the Government undertakes for him a thousand duties that it has no business with. It builds schools and asylums for him; it protects him against disease, and, if needful, furnishes him with physicians and medicines; it sees that he has good beef and pork, pure milk, and sound fruit; it refuses to permit him to drink what he pleases, though it be only the cheaper grades of tea, nor to eat chemical substitutes for butter and cheese, except they bear authorized marks; it transports his mails, supplies him with garden seeds, instructs him in the care of fowls, cattle, and horses, shows him how to build roads, and tells him what the weather will be; it insures him not only against incompetent plumbers, barbers, undertakers, horseshoers, accountants, and physicians, but also against the competition of the pauper labor of foreign countries; it creates innumerable offices and commissions to look after the management of his affairs, particularly to stand between him and the "rapacity" of the corporations organized to supply the necessaries of life at the lowest cost; it builds fleets of cruisers and vast coast fortifications to frighten away enemies that never think of assailing him, and to inspire them with the same respect for "the flag" that he is supposed to feel. Indeed, there is hardly a thing, except simple justice, cheap and speedy, that it does not provide to fill him with a love of his country, and to make him ready to immolate himself upon her altars.

But I can not repeat with too much emphasis that every expenditure beyond that required to maintain order and to enforce justice, and every limitation of freedom beyond that needful to preserve equal freedom, is an aggression. In no wise except in method does it differ from the aggressions of war. In war the property of an enemy is taken or destroyed without his consent. In case of his capture his conduct is shaped in disregard of his wishes. The seizure of a citizen's property in the form of taxes for a purpose that he does not approve, and the regulation of any part of his conduct not violative of the rights of his neighbors, are precisely the same. If he is forbidden to carry the mails and thus earn a living, his freedom is restricted. If he can patronize no letter carrier but the Government, to which he must pay a certain rate, no matter how excessive, he has to a degree become a slave. The same is true if he can not employ whomever he pleases to cut his hair, or to fix his plumbing, or to prescribe for his health. Still truer is it if he is obliged to contribute to a system of public education which he condemns, or to public charities which he knows to be schools of pauperism, or to any institution or enterprise that voluntary effort does not sustain. In whatever way the Government may pounce upon him to force him to work for some one besides himself and to square his conduct with notions not his own, he is still a victim of aggression, and the aggression is none the less real and demoralizing because it is not committed amid the roar of cannon and the groans of the dying.

To what extent the American people have become victims of this kind of aggression can not be determined with precision. Still, an idea may be had from the volume of laws enacted at every legislative session, and the amount of money appropriated to enforce them. A commonplace little appreciated is that every one of them, no matter what its ostensible object, either restricts or contributes to individual freedom. The examination of any statute-book will soon make painfully apparent the melancholy fact that the protection of individual freedom figures to the smallest extent in the considerations of the wise and benevolent legislator. Of the eight hundred enactments of the Legislature of the State of New York in 1897, for example, I could find only fifty-eight that had this supreme object in view. If we apply the same ratio to the work of all the legislatures of the country, and, allowing for biennial sessions, make it cover a period of two years—namely, 1896 and 1897—the astonishing result will be that, of the 14,718 laws passed, all but 1,030 aim, not to the liberation but to the enslavement of the individual. But to this restrictive legislation must be added the thousands of acts and ordinances of town, city, and county legislatures that are more destructive of freedom even than the State and Federal legislation. If not more numerous, they are certainly more minute, meddlesome, and exasperating.

As to the amount of plunder passing through the hands of the modern *condottieri*, that is susceptible of an estimate much more accurate. If we take the expenditures of all the governments of the United States, Federal, State, municipal, county, and town, for a similar period of two years, they reach the enormous total of two billion dollars, equal to more than two thirds of the national debt at the close of the civil war.* Of this sum only about one hundred

* In order to get at the full amount of plunder, I ought to know how much the beneficiaries of tariff and other laws pocket. But statistics on this point are unfortunately not to be had. The amount must, however, be very large.

and twenty million dollars, or six per cent, are devoted to the legitimate functions of government—namely, the maintenance of police and courts—and one hundred and forty million dollars to the support of the military establishment.* All the rest is expenditure that should no more be intrusted to the Government—that is, subject to the application of political instead of business methods—than the expenditure of a household, or a farm, or a cotton mill, or an iron foundry. Even if it were a legitimate expenditure of the Government, it could not be collected nor expended without injustice. Tax laws have never been and never will be framed that will not permit some one to escape his share of the burdens of the community; and the heavier those burdens are, as they are constantly becoming to an alarming degree, the more desperate will be the effort to shirk them—the more lightly will they rest upon the dishonest and unworthy, and the more heavily upon the honest and worthy. Moreover, it has never been possible, and it never will be possible, to expend money by political methods without either waste or fraud, and most usually without both.

Such a volume of legislation and taxation permits of the easy detection of the vital difference between the theory and practice of politics. According to the text-books and professors, politics is the science of government. In countries like the United States, where popular institutions prevail, the purpose of its study is the discovery and the application of the methods that shall enable all citizens, rich and poor, to share alike in the inestimable privilege of saying what laws they shall have, and bear in proportion to their means the burdens it entails. Such a privilege is supposed to confer innumerable benefits. Every one is assured of scrupulous justice. He is made to feel profound gratitude for his happy deliverance from the odious tyranny and discrimination of a monarchy or an aristocracy. The participation of everybody in the important and beneficent work of government possesses a rare educational value. It leads the ignorant and indifferent to take a deep interest in public questions, and to attempt, as their strength and ability allow, the promotion of the welfare of their beloved country. Thus they escape the deplorable fate of burial in the sordid and selfish pursuit of their own affairs, and the consequent dwarfing of their minds and emotions. Rising to broader views of life and duty, they become patriots, statesmen, and philanthropists.

Enchanting as this picture is, one that can be found in the speeches of every demagogue, male and female, as well as in the works of every political philosopher of the orthodox faith, it has no

* These figures represent the expenditures before the war with Spain. That deplorable event will increase them considerably.

sanction in the practice of politics. As long as the greater part of legislation and taxation has nothing whatever to do with government, properly speaking, politics can have no kinship with any pursuit held in esteem by men truly civilized. What it consists of may be reduced to a desperate and disgraceful struggle between powerful organizations, sometimes united, like the Italian *condottieri* and the Spanish brigands, in the form of "rings," to get control of the annual collection and distribution of one billion dollars, and to reap the benefits that grow out of the concession of privileges. The legislation placing this vast power in the hands of the successful combatants is only an incident of their work. It simply enables them under the form of law to seize the taxpayer, bind him like another Gulliver with rules and regulations, and to take from him whatever they please to promote their political ambition and private interests. From this point of view it is easy to see that politics has no more kinship with science or justice than pillage. Nor is it likely to make people more patriotic, high-minded, and benevolent than the rapacity of Robin Hood or Fra Diavolo.

However startling or repugnant may be this view, it is the only one that furnishes an adequate explanation of the practice of government as carried on in every democratic country in the world. The work of private business and philanthropy, the work in which modern democracies have come to be chiefly engaged, is not in itself productive of the ethics and evils of war. Contrary to the common belief, industrial competition, which is conducted by voluntary cooperation, tends to the supremacy of excellence, moral and material. In societies where civilization has made headway, a merchant or manufacturer does not seek to crush rivals by misrepresenting them or assailing them in other ways. His natural and constant aim is to have his goods so cheap and excellent that the public will patronize him rather than them. To be sure, the ethics of war often prevail in industrialism. They are not, however, one of its products; they are the fruits of militant ages and activities. But in political competition, which is coercive, the policy pursued is precisely the reverse. Not by proof of moral and material excellence does the politician establish his worth. Not by the superiority of his services or by his fidelity to obligations does he gain the esteem and patronage of the public. It is by the infliction of injury upon his rivals. He misrepresents them; he deceives them; he assails them in every way within his reach. When he triumphs over them he uses his power, not primarily for the benefit of the people whom he is supposed to serve, but to maintain his supremacy in order to pillage them. "Those who make war," says Machiavelli, whose famous book is a *vade mecum* for a modern politician as well as for an unscrupulous and a tyrannical prince, "have always and very naturally designed to enrich themselves and impoverish the enemy. Neither is victory sought nor conquest desirable except to strengthen themselves and weaken the enemy."

In the light of this truth the organization of powerful political parties becomes natural and inevitable. It is just as natural and inevitable that the more numerous the duties intrusted to the State—that is, the greater the spoil to be fought for in caucus and convention and on the floors of legislatures—the more powerful, dangerous, and demoralizing they are certain to be. Were these duties confined to the maintenance of order and the enforcement of justice, it would be an easy matter for the busiest citizen to give them the attention they required. So simple would they be that he could understand them, and so important that he would insist upon their proper performance. But when they become vast and complex, including such special and difficult work as the education of children; the care of idiots, lunatics, and epileptics; the supervision of the liquor traffic, the insurance business, and railroad transportation, and the regulation of the amount of currency needed in an industrial community, it is beyond the powers of any man, however able, to understand them all, and, no matter how much time he may have, to look after them as he ought. When to these duties are added the management of agricultural stations; the inspection of all kinds of food; the extirpation of injurious insects, noxious weeds, and contagious diseases; the licensing of various trades and professions; the suppression of quacks, fortune-tellers, and gamblers; the production and sale of sterilized milk, and the multitude of other duties now intrusted to the Government, it is no wonder that he finds himself obliged to neglect public questions and to devote himself more closely to his own affairs in order to meet the ever-increasing burdens of taxation. Neither is it any wonder that there springs up a class of men to look after the duties he neglects, and to make such work a means of subsistence. The very law of evolution requires such a differentiation of social functions and organs. The politician is not, therefore, the product of his own love of spoliation solely, but of the necessities of a vicious extension of the duties of the State. There is nothing more abnormal or reprehensible about his existence under the present *régime* than there is about the physician or lawyer where disease and contention prevail. As long as the conditions are maintained that created him, so long will he ply his profession. When they are abolished he will be abolished. No number of citizens' unions, or nonpartisan movements, or other devices of hopeful but misguided reformers to abolish him, can modify or reverse this immutable decree of social science.

Politics tends to bring to the front the same kind of men that other social disorders do. A study of political leaders in the democratic societies of the world discloses portraits that differ only in degree from those that hang in the galleries of history in Italy in the fifteenth century, in Germany during the Thirty Years' War, and in France at the height of the French Revolution. Although the men they represent may not be as barbarous as Galeazzo or Wallenstein or Robespierre, they are just as unscrupulous and despicable. Like their prototypes, some of them are of high birth; others are of humble origin; still others belong to the criminal class. They do not, of course, capture cities and towns and hold them for ransom, or threaten to burn fields of wheat and corn unless bribed to desist; still they practice methods of spoliation not less efficient. By blackmailing corporations and wealthy individuals, they obtain sums of money that would have filled with bitter envy the leaders of the famous or rather infamous "companies of adventurers." With the booty thus obtained they gather about them numerous and powerful bands of followers. In every district where their supremacy is acknowledged they have their lieutenants and sublieutenants that obey as implicitly as the subordinates in an army. Thus equipped like any of the great brigands of history, they carry caucuses and conventions, shape the party policy, and control the legislation proposed and enacted.

To be sure, the economic devastation of politics is not as conspicuous as that of war. It does not take the tragic form of burning houses, trampled fields of grain, tumbling walls of cities, and vast unproductive consumption by great bodies of armed men. Yet it is none the less real. Not infrequently it is hardly less extensive when measured in dollars and cents. Seldom does an election occur, certainly not a heated congressional or presidential election, that the complaint of serious interference with business is not universal. So great has the evil become that, long before the meeting of the national conventions in 1896, a concerted movement on the part of the industrial interests of the country was started to secure an abbreviation of the period given up to political turmoil. Even more serious is the economic disturbance due to legislatures. As no one knows what stupendous piece of folly they may commit at any moment, there is constant apprehension. "The country," said the Philadelphia Ledger, a year ago, referring to the disturbance provoked by the Teller repudiation resolution in the Senate and the violent Cuban debate in the House, "has got Congress on its hands, and, after their respective fashions, Senate and House are putting enormous weight of disturbing doubts and fears upon it. . . . To a greater or less degree a meeting of Congress has been during recent years anticipated by the community of business with timidity which in some instances has amounted to trepidation." The State legislatures are hardly better. No great industry has any assurance that it will not find itself threatened with a violent and ruinous assault in some bill that a rapacious politician or misguided philanthropist has introduced. In New York the attacks of these modern brigands have become so frequent and so serious that many of the larger corporations have had to take refuge in adjacent States,* where they can enjoy greater, if not complete immunity. In a less degree the same is true of the minor legislatures—town, county, and municipal. Ordinances for pavements or sewers or in concession of valuable privileges keep the taxpayers in a state of constant anxiety. At the same time vast harm comes from the neglect of more important matters. The time of legislators is spent in intriguing and wrangling, and the millions of dollars that the sessions cost are as completely destroyed as though burned by invaders.

Though seldom or never recognized, politics has the same structural effect upon society as war. The militant forces of the one, like the militant forces of the other, tend to the destruction of social mobility and the creation of social rigidity, making further social evolution difficult or impossible. There is a repression of the spirit of individual initiative, which calls into existence just such institutions as may be required at any moment and permits them to pass away as soon as they have served their purpose. There is an encouragement of the class and parasitic spirit, which produces institutions based upon artificial distinctions, and, like those in China, so tenacious of life as to defy either reform or abolition. To provide place and pelf for followers, political leaders, aided by the misdirected labors of social reformers, favor constantly the extension of the sphere of government in every direction. In New York, for example, during the past eighteen years, thirty-six additions to State offices and commissions have been made. Simultaneously, the expenditures on their account have grown from less than four thousand dollars a year to nearly seven million. This feudal tendency toward the bureaucracy that exists in France and Germany, and in every country cursed with the social structure produced by war, is not only the same in the other States, but in the Federal Government as well. Its latest manifestation is the amazing extension of the powers of the interstate commerce commission demanded in the Cullom bill, and the proposed establishment of a department of commerce to promote trade with foreign countries. As in New York, there has been an enormous increase in Federal expenditures. In the agricultural department it

* It has been suggested by J. Novicow that, by a competition of this kind among nations, an improvement in legislation might be forced upon them.

has been from $3,283,000 in 1887 to $23,480,000 in 1897. In other departments the increase has ranged from nineteen per cent in the legislative and twenty-three in the diplomatic and consular to seventy in the Indian, seventy-seven in the post office and river and harbor, and one hundred and thirty-three in the pension. Another manifestation is the pressing demand for the extension of the pension system to civil officials. Already the system has been extended to policemen and firemen. In some States the teachers in the public schools receive pensions, and in others the clamor for this form of taxation is loud and persistent. At the present time a powerful movement is in progress to pension the civil servants of the Government. Still another manifestation is the passage of laws in revival of the old trade and professional corporations. For a long time those in protection of the legal and medical professions have been on the statute-books, if not always in force. But, as always happens, these bad precedents have been used as arguments in favor of the plumbers, barbers, dentists, druggists, and other trades and professions. But the most absurd manifestation is the social classification of Government employees in accordance with the size of their salaries, a form of folly particularly apparent in Washington, and the establishment of patriotic and other societies, like the Sons and Daughters of the American Revolution, the Baronial Order of Runnymede, and the Royal Order of the Crown, that create social distinctions based, not upon character and ability, but upon heredity. Could anything be more un-American, to use the current word, or hostile to the spirit of a free democracy?

In the intellectual domain politics works a greater havoc than in the social. Politicians can no more tolerate independence in thought and action than Charles V or Louis XIV or Napoleon I. "I have never had confidence in political movements which pretend to be free from politics," said the Governor of New York at the close of the campaign that restored Tammany Hall to power in the metropolis, showing that the intolerance of this form of warfare does not differ from that of any other. "A creed that is worth maintaining at all," he added, using an argument made familiar by the agents of bigotry everywhere, "is worth maintaining all the time. . . . Do not put your faith in those that hide behind the pretense of nonpartisanship," he continued, striking a deadly blow at all party traitors; "it is a device to trap the thoughtless and unsuspecting." As was shown during the Blaine-Cleveland campaign of 1884, politicians treat dissent as proof of unmistakable moral and intellectual baseness. Only the progress of civilization prevents them from pouncing upon such men as George William Curtis, Carl Schurz, and Wayne McVeagh with the ferocity of the familiars of the Inquisition. As it is, they are regarded with more abhorrence than the members of the opposition; they are treated with a greater wealth of contempt and hatred, and often pursued with the malignant vindictiveness of the cruelest savages. "I submit," said Mr. Wanamaker in one of his speeches against the Quay machine, "that the service of self-respecting men is lost to the Republican party by vile misrepresentations of reputable people, employment of bogus detectives, venomous falsifiers, a subsidized press, and conspirators who dare any plot or defilement, able to exert political control, and by protecting legislation and by domination of legal appointees of district attorneys and others not in elective but appointive offices." During the memorable campaign of 1896, when political bitterness and intolerance reached perhaps the highest point in the history of the United States, thousands of voters, driven by the scourge of "party regularity," either concealed or disavowed their convictions, and marched under banners that meant repudiation of public and private obligations. Even one of Mr. Cleveland's Cabinet officers, who had stood up bravely for the gold standard, succumbed to party discipline and became an apostate. The intolerant spirit of politics extends to dictation of instruction of students. The prolonged assaults of the protectionists upon Professor Perry and Professor Sumner are well known. The same spirit inspired the attack upon President Andrews, of Brown University, the dismissal of the anti-Populist professors in the Agricultural College of Kansas, and the populistic clamor against certain professors in the universities of Missouri and Texas. That politics produces the same contempt for culture and capacity that war does, evidence is not lacking. "There is," said Senator Grady, of Tammany Hall, apologizing for the appointment of some illiterate to office in New York city, "a class of persons, chiefly the educated, who thinks that if a man begins a sentence with a small letter, or uses a small 'i' in referring to himself, or misspells common words, that he is unfit for public office. Nothing could be further from the truth," he continues, using an argument that the barbarians that overran Europe might have made; "it is an idea that only the aristocracy of culture could hold. . . . We do not want the people ruled by men," he adds, giving a demagogic twist to his reasoning, "who are above them, or who fancy they are because they have wealth or learning or blood, nor by men who are below them, but we want them ruled in a genuine democracy by men who are the representatives in all their ways of thinking, feeling, speaking, and acting, of the average man." What is wanted, in other words, is not men anxious to acquit themselves with ability and fidelity to the public interests, but men that will look after the interests of their organization and do the other work of political *condottieri*. It can, of course, be a matter of no consequence whether such men spell or speak correctly, or whether they conduct themselves like boors and ruffians.*

As implied in all that has been said, it is, however, upon morals that the effect of politics is the most deplorable. From the beginning of the discussion of the party platform and the nomination of the candidates to the induction of the successful combatants into office, the principles applied to the transaction of business play the smallest possible part. The principles observed are those of war. All the tactics needful to achieve success in the one are indispensable to success in the other. First, there is, as I have already said, an attempt to misrepresent and injure political opponents, and, next, to confuse, befool, and pillage the public. I shall not, however, describe the factional conflicts that precede a convention—the intrigue, the bribery, the circulation of false stories, and even the forgery of telegrams like the one that brought about the nomination and defeat of Secretary Folger. They exhibit only on a small scale the ethics of party warfare in general. More needful is it to illustrate these, and to make clear the vanity of any hope of moral reform through politics, or through any other agency, either religious, philanthropic, or pedagogic, as long as it remains a dominant activity of social life.

"If Mr. Gage had been a politician as well as a banker," said Senator Frye, criticising the secretary's honesty and courage at a time when both were urgently needed, "he would not have insisted upon a declaration in favor of a single gold standard. It was all right for him to submit his scheme of finance, but hardly politic to be so specific about the gold standard." Always adjusted to this low and debased conception of duty, a party platform is seldom or never framed in accordance with the highest convictions of the most intelligent and upright men in the party. The object is not the proclamation of the exact truth, as they see it, but to capture the greatest number of votes. If there is a vital question about which a difference of opinion exists, the work of putting it into a form palatable to everybody is intrusted to some cunning expert in verbal juggling. A money plank, for instance, is drawn up in such a way that the candidate standing upon it may be represented by editors and orators of easy consciences as either for or against the gold standard. The same was true for years of the slave and tariff questions; it is still true of the temperance question, the question of civil-service reform,

* As in the demand of Johnny Powers, the great Chicago boss, for the removal of Hull House from his ward, politics often leads to hostility to the work of philanthropists to ameliorate the condition of the poor. Another striking example of the same evil was the failure of a Quay legislature to provide for the maintenance of the State charitable institutions of Pennsylvania, and its sham investigation of the pitiful condition of the inhabitants of a mining district.

and of every other question that threatens the slightest party division. Again, questions are kept to the front that have no more vitality than the dust of Cæsar. Long after the civil war the issues of that contest formed the stock in trade of the politicians and enabled them to win many a battle that should have been fought on other grounds. If need be, the grossest falsehoods are embodied in the platform, and proclaimed as the most sacred tenets of party faith.

When the campaign opens, the ethics of the platform assume a more violent and reprehensible shape. Not only are its hypocrisies and falsehoods repeated with endless iteration, but they are multiplied like the sands of the beach. Very few, if any, editors or orators pretend to discuss questions or candidates with perfect candor and honesty. Indeed, very few of them are competent to discuss them. Hence sophistry and vilification take the place of knowledge and reason. Were one party to adopt the Decalogue for a platform, the other would find nothing in it to praise; it would be an embodiment of socialism, or anarchism, or some other form of diabolism. If one party were to nominate a saint, the other would paint him in colors that Satan himself would hardly recognize. Not even such men as Washington and Lincoln are immune to the assaults of political hatred and mendacity. As the campaign draws to a close, we have a rapidly increasing manifestation of all the worst traits of human nature. In times of quiet, a confessed knave would scarcely be guilty of them. False or garbled quotations from foreign newspapers are issued. The old Cobden Club, just ready to give up the ghost, is galvanized into the most vigorous life, and made to do valiant service as a rich and powerful organization devoted to the subversion of American institutions. Stories like Clay's sale of the presidency are invented, and letters, like the Morey letter, are forged, and, despite the most specific denials of their truth, they are given the widest currency. Other forms of trickery, like the Murchison letter, written by the British minister during Mr. Cleveland's second campaign, are devised with devilish ingenuity, and made to contribute to the pressing and patriotic work of rescuing the country from its enemies.

But this observation of the ethics of war does not stop with the close of the polls, where bribery, intimidation, and fraud are practiced, and the honest or dishonest count of the ballots that have been cast; it is continued with the same infernal industry in the work of legislation and administration. Upon the meeting of the statesmen that the people have chosen under "the most perfect system of government ever devised by man," what is the first thing that arrests their attention and absorbs their energies? More intriguing, bargaining, and bribery in a hundred forms, more or less subtle, to secure election and appointment to positions within the gift of the legislature. Little or no heed is given to the primary question of capacity and public interests. Political considerations—that is, ability to help or to harm some one—control all elections and appointments. What is the next thing done? It is the preparation, introduction, discussion, and passage of the measures thought to be essential to the preservation of civilization. Here again political considerations control action. Such measures are introduced as will strengthen members with their constituents, or promote "the general welfare" of the party. Very rarely have they "the general welfare" of the public in view. Sometimes they seek to change district boundaries in such a way as to keep the opposition in a perpetual minority. Sometimes they have no other motive than the extortion of blackmail from individuals or corporations. Sometimes their object is to throw "sop to Cerberus"—that is, to pacify troublesome reformers within the party, like the prohibitionists and the civil-service reformers. Sometimes they authorize investigations into a department or a municipality with the hope that discoveries will be made that will assist the party in power or injure the party out of power; it happens not infrequently that they are undertaken to smother some scandal, like the mismanagement of the Pennsylvania treasury, or to whitewash some rascal. Sometimes they create commissions, superintendents, or inspectors, or other offices to provide rewards for party hacks and heelers. Finally, there are the appropriation bills. Only a person ignorant of the ways of legislators could be so simple-minded as to imagine that they are miracles of economy, or that they are anything else but the products of that clumsy but effective system of pillaging known as log-rolling, which enables each to get what he wants with the smallest regard for the interests of the taxpayer.

It is, however, during the debates over these wise and patriotic measures that the public is favored with the most edifying exhibition of the universal contempt of the legislator for its interests. They disclose all the scandalous practices of a political campaign. There are misrepresentations, recriminations, and not infrequently, as in the case of Sumner, personal assaults. A perverse inclination always exists toward those discussions that will put some one "in a hole," or enable some one to arouse party passion. For this purpose nothing is so effective as a foreign question, like a Cuban belligerency resolution, or a treaty for the annexation of Hawaii, or a domestic question, like responsibility for the crime of 1873, or the panic of 1893, or a comparison of party devotion to the interests of the "old soldier." Not the slightest heed, as has been shown on several occasions during the past few years, is paid to the shock that may be given to business or to the disturbance of pacific relations with foreign powers. In fact, the greater the danger involved in the discussion of a delicate question, the more prone are the demagogues to mouth it. To such questions as bankruptcy, railroad pooling, and currency reform will they give their time and wisdom only when business interests have almost risen in insurrection and compelled attention to them.

The same policy of hypocrisy, deception, favoritism, and proscription is a dominant trait of the administration of the Government. The object almost invariably in mind is the welfare or injury of some party, or faction, or politician. The interests of the public are the last thing thought of, if thought of at all. Take dismissals and appointments. They may, as has been known to occur even in the United States, be made to better the public service. Even then a careful study of motive will disclose the characteristic purpose of the politician. In a choice between two men of equal ability, or rather of equal inability, which is more commonly the case, preference is given to the one with the stronger "pull." Often, as has been shown within the past year or two, convicted rascals are appointed at the behest of Congressmen and in defiance of the wishes of the business community, and, in spite of the civil-service laws, officials are dismissed because of their politics alone. In the letting of contracts it is not difficult to detect the observance of the same judicious rule. The virtuous formality of letting to the lowest bidder may be gone through with, and the public may be greatly pleased with this exhibition of official deference to its interests. Yet an examination of the work done under the supervision of complaisant inspectors, who may be blinded in various ways to the defects of that of a political friend, or made supernaturally alert to the defects of that of a political enemy, will reveal a trail that does not belong to scrupulous integrity. That is why dry docks, like that in Brooklyn, why harbor works, like those in Charleston, turn out defective; why the Government has to pay more for the transportation of the mails than a private corporation; why the cost of the improvement of the Erie Canal was concealed until nearly all the money voted for the folly had been expended; why of the money expended one million dollars was wasted, if not stolen; why so much of the State Capitol at Albany has been built over again; why the City Hall in Philadelphia has been an interminable job; why the supplies of prisons, asylums, and other public institutions are constantly proving to be inferior to those paid for—why, in a word, everything done by political methods is vitiated by the ethics of war. In the enforcement of laws very little justice or honesty can be found. As a rule, they bear much more harshly on the poor and weak, that is, those with small political influence, than on the rich and strong, that is, those with much political influence. Take the enforcement of liquor laws, health laws, factory laws, and compulsory school laws. If a man with political influence wishes to keep his children at home for any purpose, no truant officer is indiscreet enough to trouble him; if, however, a poor woman, just made a widow, wishes to have her oldest son work in disregard of the statute, in order to keep her and her younger children out of the poorhouse, his official zeal is above criticism. Politics poisons even the fountains of justice. Criminals that have sufficient political influence can escape prosecution or obtain pardon after conviction. Prosecuting officers are importuned incessantly, even by "leading citizens," to abandon prosecution of them or to "let them off easily." In the appointment of receivers and referees, judges are much more inclined to give preference to political friends than to political enemies. Finally, if political exigencies require it, there is no hesitation to invoke the latent savagery of a nation. In proof, recall the Venezuelan message of Mr. Cleveland, which "dished" the Republican jingoes, and the German emperor's assault upon Hayti and China to secure the adoption of his naval bill. To make the record complete, I ought to add that for a purpose more odious—namely, the increase of sales—newspapers, always the ready recipients of political patronage, commit the same atrocious crime against civilization.

Since politics is a form of civil war, involving aggressions upon person and property, any extension of its field of operation must be attended by precisely the same moral and economic effects that attend the pursuit of civil war itself. No concession of suffrage to women, nor any legal machinery, however ingenious, that may be invented, will alter that fact. Already we are confronted with alarming manifestations of the decadence of society that have always accompanied civil strife. The public burdens are becoming so great, equaling the per capita rate prevailing at the outbreak of the French Revolution, that people in cities as well as in the country are being driven from their homes by the sale of their property for unpaid taxes. Both classes are joining the ranks of "the disinherited," just as similar classes joined the brigands in France and Italy, and are clamoring for the trial of the thousand absurd schemes for social ills known as populism and socialism, all meaning an increase of the functions of government, still further aggressions upon persons and property, and an aggravation of the evils already complained of. At the same time the moral tone of society is rapidly sinking to a low level. "It is a melancholy reflection," says the report of the New York State tax commission, dwelling upon the desperate efforts of people to escape the aggressions committed on them and disclosing the observance of a code of ethics committed in every walk in life, "that in this Christian age neither the memory of early moral training, nor present religious profession, hopes or fears for the hereafter, the penalties of the law, nor any other possible considerations are sufficient to restrain the average possessor of personal property from forcing other men to pay the taxes for which he is justly liable, by methods unquestionably immoral, if not absolutely criminal." Further evidence of the same startling and deplorable fact, one recalling the cruel indifference of the privileged classes of the ancient *régime* to the sufferings of the people that bore the burdens that they ought to have shared, is to be found in the universal tendency of people to get public improvements at the expense of others, such as free baths, normal schools, interoceanic canals, etc., and the shocking prevalence of crimes of violence in every part of the country. To be sure, there are coupled with this alarming decadence extraordinary religious, philanthropic, and pedagogic efforts to rescue society from the depths of degradation to which it is sinking. But, as is shown by the history of the unparalleled moral enthusiasm of thousands of ascetics and teachers of the highest character during the decadence of Rome and the disorders of the middle ages, they will be absolutely ineffective as long as the conditions prevail that engender envy, hatred, deception, plunder, and murder, destroying not only morality, but every vestige of fellow-feeling and patriotism. "There is a nation," says Mr. Bodley in his new book on France, bringing out this profound and important truth, "to the members of which Frenchmen are more revengeful than to the Germans, more irascible than to the Italians, more unjust than to the English. It is to the French that Frenchmen display animosity more savage, more incessant, and more inequitable than to any other race." Precisely the same effect is to be noticed in the United States—the inevitable effect of every form of aggression, even though it have the most benevolent object in view.

Yet the conclusion is not that people should abstain from politics. That would involve greater evils than those that now prevail. It would be submission to aggression—freedom to predatory politicians to continue their pillage. The thing to be done is to take up arms against them, and to wage relentless war on them. But the object of the struggle must not be the substitution of one set of politicians for another, but to reduce to the smallest possible limits the sphere of all political activity. Until this is done there can be no release from so important a duty to self and to the community.

Sir W. Martin Conway, with his two Swiss guides, Antoine Maquiguez and Louis Pellissier, on September 9, 1898, reached the top of Yllimani, Bolivian Andes, near La Paz. The party were five days reaching the summit, 22,500 feet above the sea, from the highest point of cultivation. The guides were the same who ascended Mount St. Elias in 1897 with Prince Luigi of Savoy.

MY PET SCORPION.

By NORMAN ROBINSON.

WHEN I first came to Florida I heard terrible accounts of the deadly work of a poisonous "bug," popularly known as the "grampus" or "mule-killer."

My first informant was a "Florida cracker," who seemed fairly intelligent, and whom I had employed in a little woodcraft. He happened to encounter one of those terrible creatures, and promptly "smashed" it with his axe. On expressing regret that I had no opportunity of seeing it before it was crushed into so shapeless a mass, he gravely assured me that he "didn't take no resks on them varmints. Them's the pisenest things in Floridy. Rattlers ain't nowhar! A man what gits bit by one of them critters—no medicine can't save him! We calls 'em mule-killers, cause they's wust on mules. A hoss nor a dog don't seem to mind 'em, but a mule is done dead when one of them varmints strikes 'em."

I cross-questioned my informant a little as to his personal knowledge of the matter, and especially as to the fatal results following the bite of this very astonishing "bug." "Did you ever know," said I, "of a mule's dying from the bite of this 'mule-killer'?"

"Oh, yes, I've knowed of several, and I hearn tell of lots. Ole man Jernigan, he loss a likely mule what got struck by one of them critters, and there was a man what died down to the Johnson place, bit by one of them things. They tells me he took whisky enough to kill two men, but it didn't do him no bit of good. He was powerful fond of whisky, anyway, and he died mighty easy."

I subsequently made some inquiries in regard to these supposed casualties, and came to the conclusion that my informant's accounts of them were largely mythical. A mule had died in the neighborhood mentioned, but the "mule-killer" was colic; and in the case of the man, although he claimed to have been bitten by a "grampus," it was generally believed that the "serpent of the still" was the most deadly "varmint" he had recently encountered.

I soon found, however, that the belief in the venomous character of this "whip scorpion," or *Thelyphonus giganteus*, as it proved to be, was almost universal. The negroes, especially, are in mortal terror of it. Only a few days since a colored boy that I had employed in hauling wood brought me a small specimen, completely crushed, with the triumphant announcement, "I've got him, but he like to done strike me 'fore I seed him."

"But how do they bite?" I asked, "with their claws?"

"Dey don't bite at all! Dey jes' strike you with de tail, and dey's a pizen juice comes out, and den no doctor kain't save you!"

Newspaper stories confirming this belief occasionally go the rounds. I remember reading one particularly circumstantial account of the mishaps of a camping party somewhere in south Florida. "They were a long way," said this veracious chronicler, "from any human habitation, and the loss of their one mule from the bite of this pestiferous scorpion brought with it no end of inconvenience and trouble."

The distressing story was told with great detail, and it was certainly not calculated to diminish the popular dread with which this supposed venomous creature is regarded. Even in scientific journals we find an occasional echo of this general belief. Dr. Packard, too, certainly good authority, in his Study of Insects accepts the current theory.

In the Proceedings of the Washington (D. C.) Entomological Society there is an interesting discussion of this very question (vol. ii, No. 2). Professor Howard stated that a case of the bite of the *Thelyphonus* with fatal results was vouched for by a Mr. Dunn, a professed naturalist, and that his testimony was entitled to weight. Mr. Ashmead and Mr. Banks, both of whom had been familiar with the *Thelyphonus* in Florida, had handled them frequently, and believed them harmless. Dr. George Marx confirmed this view by stating that dissection failed to show the presence of any poison sac or fangs, a statement which it seems has been confirmed by subsequent investigations.

Altogether here was a "muddle" of conflicting testimony, which could only be accounted for by supposing "some one had blundered."

A few months since, for my own satisfaction, I determined to make a special study of our Florida "grampus." Not the least curious question that first suggests itself is how this name, "grampus" (French, *Grand poisson, great fish*), one of the *Cetaceæ*, ever got tacked on as a popular label for our Florida *Thelyphonus*. I am utterly at a loss to account for it.

Before catching "my bird" I, of course, had to make a cage for it. This was constructed out of a large cigar box. About half of one end was removed and replaced by wire gauze. In addition to the hinged wooden cover, with which the box was furnished, I arranged a second one of wire gauze, hinged on the opposite side, and closing underneath the wooden one. This gave full control of light and air, both by day and night, without disturbing my future prisoner, and at the same time diminished the danger of his escape.

I knew very well that the scorpion I was after was of a very modest and retiring disposition, and was never seen above ground in daylight except by accident or mistake. I was also under the impression that they were becoming rather rare, as it was more than a year since I had seen one. Still, it was with the most abundant confidence, to say nothing of the more prosaic requisites of a stout pair of gloves, a paper bag, and a hoe, that I started out one afternoon to find my *Thelyphonus.* I directed my course to the nearest wood, not for a moment doubting that a few hours' work would bring to light the object of my search. I labored faithfully until dark, overturning rotten logs, sticks, bark, old rails, and other field and woodland *débris* under which my "grampus" would be likely to be hiding, but the search was altogether fruitless.

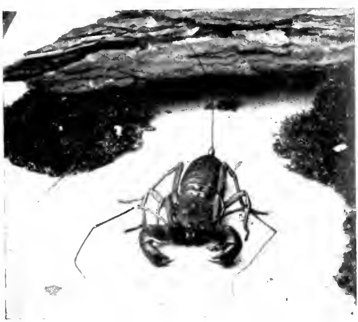
I then concluded to try a plan which I have usually found quite successful. I told some of the bright boys in town what I wanted, and offered them a liberal price for every live "grampus" they would bring, cautioning them that their bite was said to be poisonous, and at the same time instructing them exactly how to catch and handle them. This scheme was also a failure. I then asked several friends who are interested in natural history to aid me in the search. One gentleman, who is a surveyor, and who in the pursuit of his profession passes much of his time in the woods, entered with special interest into my quest. These plans were all equally barren of results.

One day, after I had practically given up the search, I was hoeing among the sprouts at the base of an old orange tree that had fallen a victim to the "big freeze" when, under a pile of chips at the base of the old stump, I suddenly unearthed my long-looked-for *Thelyphonus.* It was a fine, full-grown specimen, decidedly resentful at this sudden intrusion upon its privacy, and if a formidable pair of expanded claws, brandishing tail, and a generally vicious look meant anything, it was a customer that a prudent man would not care to pick up with bare hands. With the aid of a wide-mouthed preserving jar and a stick it was, however, soon secured, and in a short time transferred to the cage that had been so long waiting for its occupant.

A few words may not be amiss concerning the great family of which my little captive is not the least interesting member. The *Thelyphonidæ* belong to the great spider family, *Arachnida*, which includes not only the true spiders, but also the mites (*Acarids*), the ticks (*Ixodes*), the *Tartarides*, *Phrynides*, *Phalangides*, and other more or less related and mostly tropical groups. The whole subclass has certain pretty well-defined characteristics. They are almost without exception carnivorous (*insectivorous*). They are seldom subject to metamorphosis. The legs are usually eight in number. The eyes are always situated on the cephalo-thorax (head and breast plate), and not infrequently are the same in number as the legs. Not a few are fitted with poison sacs and fangs, and in the case of some of the larger true spiders and scorpions the venom is very virulent, and in some instances has proved fatal to human life.

As this is hardly the place for a technical description of my *Thelyphonus*—a female—I shall content myself with a few facts and measurements. Those who are curious as to her personal appearance can consult the accompanying photograph. Most persons will conclude that her beauty is not even "skin deep."

The following post-mortem data will perhaps aid in giving a clearer idea of this curious little creature. The length of the body from the front of the cephalo-thorax to the end of the last post-abdominal segment was fifty-two millimetres — a little more than two inches; the length of the tail was fifty millimetres, thus making the total length about four inches. The width of the abdomen in its widest part, near the center, was thirteen millimetres, or approximately half an inch. The claw-bearing palpi, or "feelers," which are large and very powerful, have an extreme expansion of fifty-eight millimetres, nearly two and a half inches. The tail is a curious organ, and consists of forty-four short, jointed sections of a pale wine color, with a light yellow ring at the base; a few short, scattered pointed hairs are found on each segment. It is about two thirds of a millimetre in thickness at the base and tapers to about half this diameter at the end. When alarmed, the *Thelyphonus* holds it curved over forward after the manner of the true scorpions; a habit that probably points to some common ancestor. Its true function appears to be that of an extra palpus or "feeler."



The *Thelyphonus* is generally of a wine color. In some places, as on the cephalo-thorax, this color is black; around the mouth parts, the legs, the sternal plate, and the under side of the abdomen, this wine color is very pronounced.

The eyes are eight in number. Two of them are close together, on opposite sides of a slightly elevated ridge at the front of the cephalo-thorax. These eyes are bright, black, and beadlike, and about two thirds of a millimetre in diameter. A little farther back, on the outer edges of the cephalo-thorax, are placed the remaining six eyes, three on a side, in a triangular group. These eyes are not quite as large as those in front, but they are of a shining yellow color, and altogether give the face of the whip scorpion a decidedly uncanny look.

But to return to the history of my pet. As Madam Thelyphonus had obviously been accustomed to rather primitive furniture, I did not overburden her new apartments. A thickly sanded floor, a salt dish filled with fresh water, a square of pine bark the size of my hand, slightly elevated, with a few nice pieces of green moss to remind her of the country home she had left, and my involuntary guest was ready for housekeeping. She accepted her new quarters without question or examination, and promptly retired to her bedroom under the bark.

But housekeeping, even for a whip scorpion, involves the food question. Here I was upon uncertain ground. The strictly nocturnal habits of the *Thelyphonus* render all such investigations difficult. Naturally, the authorities on this point are somewhat indefinite or conflicting. The first things which I placed in the cage were a number of roaches of assorted sizes. One investigator claims that they are readily eaten by the *Thelyphonus.* Twenty-four hours passed and not a roach was missing.

The matter, however, in which I felt a more immediate interest was the supposed venomous character of my new pet. My experiments were, therefore, especially directed to the settlement of this question. The next night a large, full-grown toad, that for some time had made his home in my back yard, was placed in the cage. The roaches were still there, and right here a very interesting thing happened. The largest cockroach, nearly two inches in length, was upon the side of the cage. The toad had hardly got comfortably seated immediately in front of him when the cockroach suddenly disappeared. I could not say that I saw him disappear. I was looking directly at both, but the "dissolving view" was too rapid for the eye to follow. To say that it was "quick as a flash" would depend somewhat on what kind of a "flash" was meant. I think nitroglycerin would undoubtedly have kept up with my *bufo;* but, judging from what I saw, or rather didn't see, I should say that this toad could have swallowed about six cockroaches while gunpowder was getting ready to go off! Any one who wishes to get an entirely new view of the meaning of the phrase "with neatness and dispatch" should by all means try this "lightning combination" of cockroaches and a Florida toad!

And now I was all ready for the coming "battle royal" that I had reason to suppose would take place between my little captives.

I cautiously removed the bark under which Madam Thelyphonus was hiding, and then awaited results.

They didn't come. The *Thelyphonus* kept perfectly still, ditto the toad. I must stir them up. With a stick I tried to irritate the scorpion. She proved a perfect marvel of patience. She wouldn't "irritate" worth a cent. I poked the toad over and on top of the supposed vicious and venomous creature. The latter crept out from under her unusual burden and crawled into a corner. The toad in a dazed sort of way pulled himself together and hopped off. I still kept up my pokings and proddings, thinking that possibly my "grampus" could at last be teased into some manifestation of her supposed deadly powers. It was a complete failure. Madam Thelyphonus proved to be a perfect model of patient endurance under persecution. All I could do, there was not a sign or motion of resentment. She could not be teased or tormented into biting, pinching, or fighting anything or anybody. My little captive had all the "ornaments of a meek and quiet spirit," and her only desire seemed to be to get out of the way. Now here was certainly a curious contrast between reputation and real character. A whole Stateful of slanderous natural history was disappearing under my very eyes! "Mule-killer," indeed! Why, my little captive couldn't be coaxed or goaded into harming a fly. In patient sufferance and persistent good nature she could have given points to "Uncle Toby," in his celebrated interview with that annoying insect. Still, although this first experiment quite convinced me that my *Thelyphonus* was entirely harmless, I concluded to leave my captives together for the night. In the morning, as I expected, both were in the best of health and spirits, the toad eager to jump out, the scorpion eager to be let alone.

The next night I tried a mouse. This sharp-toothed, frisky little rodent would, I thought, be likely to get into trouble if there was any to be found. The teasing process was not repeated, as it had proved such a complete failure. The mouse, however, ran round the cage, tumbling over the *Thelyphonus*, in the most rapid and reckless way. Every time the latter seemed to regard these awkward encounters as unavoidable accidents, and excused them accordingly. As to biting, pinching, or resenting them in any way, she showed not the slightest symptom of them. She simply crawled into a corner and kept as quiet as circumstances would permit. As in the case of the toad, both were left together overnight. All that really happened, so far as I could see, was that the mouse had nearly gnawed a hole through the cage; but evidently he was none the worse for having shared his bedroom with this terrible "mule-killer," "worse than a rattlesnake," according to the accepted belief.

It is certainly a curious question how so perfectly harmless a creature can have acquired such a bad reputation. I know of no modern parallel. In Shakespeare's time a similar popular prejudice was entertained against one of the most useful servants that farmers and horticulturists possess. The well-known lines—

> "The toad, ugly and venomous,
> Holds yet a precious jewel in its head"—

were but the echo of this crude and cruel fancy. So with our *Thelyphonus*. It is not only absolutely harmless, but, as I shall soon show, one of the most useful helps in keeping within bounds one of our most serious pests.

The comment that I once heard, by a not over-intelligent and somewhat profane individual, upon seeing a dead whip scorpion—"Any —— fool can see that that critter is rank pisin!"—probably partially explains the matter. It must be conceded that the looks of the *Thelyphonus* are decidedly against it. Its long, frisky tail, its big, threatening claws, and its generally uncanny and vicious appearance are quite sufficient to inspire caution if not positive dread. It "looks pisin," and that settles it with the ignorant. With the better informed the fact that the creature belongs to a bad family, that its nearest relatives are unquestionably venomous, may help to explain, though it can hardly excuse, the widespread currency which even scientific men have helped to give to a most erroneous and slanderous belief.

And now as to the food question. This, of course, was a very vital matter to my little prisoner, and one of great interest to me. After the failure of the cockroach diet, I next tried grasshoppers. These also have been declared to be greatly relished by the *Thelyphonus*. I did not find it so. The first one placed in the cage was, to be sure, partially eaten. But, unfortunately, a colony of ants had got into the cage, and were dining on my dead *Gryllus*. This left the matter a little uncertain. On fencing out these intruders, and repeating the experiment with the same and half a dozen other species, I became convinced that my *Thelyphonus*, at least, was not fond of grasshoppers. Then began a kind of general system, or no system, of haphazard feeding, or rather trials of food. My marketing range for my particular "boarder" was by no means a limited one. During the month of September, when most of these investigations were in progress, Florida is by no means deficient in insect life. Every day from two to ten new and different species were placed in the cage. A list was kept, to avoid repetition, until my captive was offered her choice of something over a hundred varieties of "bugs," worms, grubs, spiders, ants and their eggs, lizards, butterflies, etc.—everything, indeed, that I could think of or conveniently catch, which it seemed possible my little captive might fancy. Of all this heterogeneous collection, nothing, so far as I could see, was ever killed or eaten. A tiny piece of fresh beef, placed in her cage at night, was the only thing that I could persuade her to touch. Even of this I am not absolutely certain. In the morning these little pellets of fresh meat were usually found rolled in the sand and often apparently diminished in size. Several times they disappeared altogether. The presence, however, of other predatory insects sometimes left the matter a little in doubt. But, as my captive remained in good health for over a month while this plan of trial dieting was in progress, I am inclined to think that more or less of the fresh beef was really consumed by her. Still, she took the greatest care that I should never catch her eating, even when surprised with a sudden light at night, a time when she was always especially active.

I was getting a little tired of this seemingly fruitless investigation, and had about concluded to persuade my *Thelyphonus* to crawl into a bottle in company with a few drops of chloroform, to have her picture taken, and then forward the "embalmed remains" to the Museum of Natural History in Central Park, New York, to which they had already been promised.

I concluded, however, to make one more effort. So the next day I spent some time in hunting for new and untried insects, of which I procured half a dozen or so, and among other things quite a lot of so-called "wood-lice," "white ants," *termites*, our only representative of a family that in most warm countries is so destructive to exposed wooden structures. All of these "finds" were tumbled, as usual, upon the floor of my captive's cage, and I left them with very little expectation that she would see among them anything that suited her fastidious taste. The next morning, to my surprise, every white ant had disappeared; nothing else was touched. The question was solved. For about three weeks my *Thelyphonus* was supplied each day with a liberal allowance of what in this latitude, at least, seems to be its exclusive food.

Now, this white ant (*Termes flavipes*) is in Florida one of our worst pests. Possibly there may be some compensating benefits which they confer, in the more rapid removal of decaying vegetable matter. In most respects, however, they are an unmitigated nuisance. The annual destruction of property, of fencing, building foundations, and exposed woodwork of every kind must be estimated at hundreds of thousands of dollars. The worst of it is, too, that it is impossible to know when they are at work. They are always hidden. In case they are compelled in their destructive labors to pass over the outside of anything, they always build a hard gallery of cemented sand or clay, under which they travel securely. Unfortunately, too, they do not always confine their ravages to dead wood. Every orange grower fears them, and if they once get a foothold the tree that they attack is often destroyed before anything is suspected to be the matter. They "love darkness rather than light," and "their deeds are evil." And it is these miserable pests that my little-appreciated and much-slandered *Thelyphonus* has been all her life fighting! And those big, strong claws of hers, that look so formidable, what are they for but to tear down and break in pieces the hard, honeycombed structures in which her food is hidden? It was all plain enough now!

I confess, when I first discovered these facts which turn popular natural history so completely topsy-turvy, I felt like taking off my hat and making my profoundest bow to my little captive, and in the name of justice and humanity asking pardon for all the slanders and indignities heaped upon her race.

Since writing the above, a private note from Prof. L. O. Howard, chief of the Division of Entomology in the United States Department of Agriculture, Washington, D. C., furnishes important additional testimony upon the question of the harmlessness of this arachnid. Professor Howard says, "The *Thelyphonus* is not poisonous."

Perhaps a way of reconciling at least some of the conflicting statements that have been made on the subject may be found in the facts revealed by modern bacteriological investigations. It is well known that under special conditions the bite of the most harmless animal may convey to the human system pathogenic germs which will speedily prove fatal. Most of the deaths reported in the newspapers from the bite of the *Thelyphonus* are no doubt imaginary, or due entirely to other causes. Any well-authenticated case—if such there has been—is probably to be explained in the manner above indicated. This theory, too, helps to "let down easy" some prominent naturalists whose great names have served to give countenance to one of the most widespread and persistent errors in current natural history.

In a memorial address of the late Dr. James Hall, made at the recent meeting of the Geological Society of America, Secretary H. L. Fairchild referred to Dr. Hall's development as almost coeval with that of the science of geology in America, and his sixty-two years of activity as connecting the work of the self-taught pioneers in this branch with the widespread field of activity of to-day. Dr. Hall's accuracy and well-balanced observation had made his first work, a report on the Geology of Western New York, a classic of the science to-day.

THE PEOPLES OF THE BALKAN PENINSULA—THE GREEK, THE SLAV, AND THE TURK.*

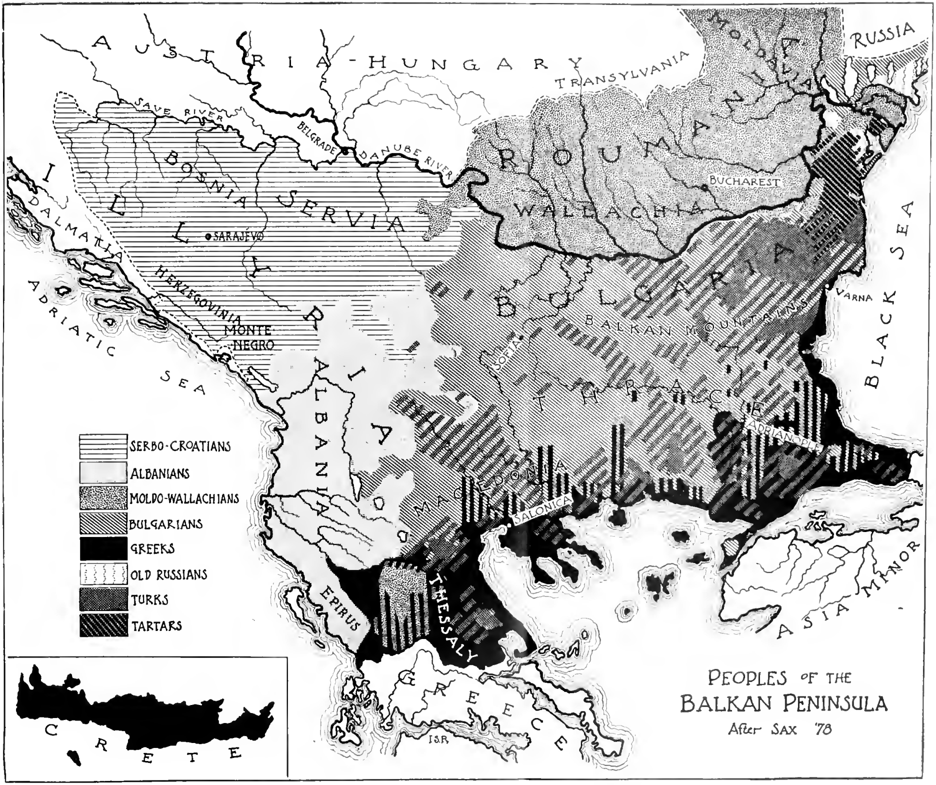
By WILLIAM Z. RIPLEY, Ph. D.,
ASSISTANT PROFESSOR OF SOCIOLOGY, MASSACHUSETTS INSTITUTE OF TECHNOLOGY; LECTURER IN ANTHROPO-GEOGRAPHY AT COLUMBIA UNIVERSITY.

THE significant geography of the Balkan Peninsula may best be illustrated by comparing it with the other two south European ones, Italy and Spain. The first point to notice is that it is divided from the mainland by rivers and not by a well-defined mountain chain. Iberia begins definitely at the Pyrenees, and Italy proper is cut off from Europe by the Apennine chain. On the other hand, it is along the line of the Danube and of its western affluent, the Save (see map between pages 614 and 615), that we find the geographical limits of the Balkan Peninsula. This boundary, as will be observed, excludes the kingdom of Roumania, seeming to distinguish it from its trans-Danubian neighbor Bulgaria. This is highly proper, viewed from the standpoint of geography and topography. For Roumania is, for the most part, an extensive and rich alluvial plain; while the Balkan Peninsula, as soon as you leave the Bulgarian lowlands, is characteristically rugged, if not really mountainous.

From Adrianople west to the Adriatic, and from the Balkan Mountains and the Save River south to the plains of Epirus and Thessaly, extends an elevated region upward of two thousand feet above the sea, breaking up irregularly into peaks often rising above five thousand feet. There is no system in these mountains. The land is rudely broken up into a multitude of little "gateless amphitheaters," too isolated for union, yet not inaccessible enough for individuality. As White observes, "If the peninsula, instead of being the highly mountainous and diversified district it is, had been a plateau, a very different distribution of races would have obtained at the present day." Nor can one doubt for a moment that this disordered topography has been an important element in the racial history of the region.

In its other geographical characteristics this peninsula is seemingly more favored than either Spain or Italy. More varied than the former, especially in its union of the two flora of north and south; far richer in contour, in the possession of protected waters and good harbors than Italy; the Balkan Peninsula, nevertheless, has been, humanly speaking, unfortunate from the start. The reason is patent. It lies in its central or rather intermediate location. It is betwixt

* Advance sheets from The Races of Europe, in press of D. Appleton and Company, many footnotes and detailed references being here omitted.



AUSTRIA-HUNGARY
TRANSYLVANIA
MOLDAVIA
RUSSIA
SAVE RIVER
BELGRADE
DANUBE RIVER
ROUMANIA
BUCHAREST
WALLACHIA
BOSNIA
SERVIA
ILLYRIA
DALMATIA
SARAJEVO
HERZEGOVINIA
MONTE NEGRO
ADRIATIC SEA
BULGARIA
BALKAN MOUNTAINS
VARNA
BLACK SEA
SOFIA
THRACE
ADRIANOPLE
ALBANIA
MACEDONIA
SALONICA
EPIRUS
THESSALY
GREECE
ISR.
ASIA MINOR
CRETE
SERBO-CROATIANS
ALBANIANS
MOLDO-WALLACHIANS
BULGARIANS
GREEKS
OLD RUSSIANS
TURKS
TARTARS
PEOPLES OF THE
BALKAN PENINSULA
After Sax '78

and between; neither one thing nor the other. Surely a part of Europe, its rivers all run to the east and south. "By physical relief it turns its back on Europe," continually inviting settlement from the direction of Asia. It is no anomaly that Asiatic religions, Asiatic institutions, and Asiatic races should have possessed and held it; nor that Europe, Christianity, and the Aryan-speaking races should have resisted this invasion of territory which they regarded in a sense as their own. In this pull and haul between the social forces of the two continents we finally discover the dominant influence, perhaps, which throughout history has condemned this region to political disorder and ethnic heterogeneity.

As little racial as of topographical system can we discover in this Balkan Peninsula. Only in one respect may we venture upon a little generalization. This is suggested by the preliminary bird's-eye view which we must take as to the languages spoken in the peninsula. This was a favorite theme with the late historian Freeman. It is developed in detail in his luminous writings upon the Eastern question. The Slavs have in this part of Europe played a rôle somewhat analogous to, although less successful than, that of the Teutons in the west. They have pressed in upon the territory of the classic civilizations of Greece and Rome, ingrafting a new and physically vigorous population upon the old and partially enervated one. From some center of dispersion up north toward Russia, Slavic-speaking peoples have expanded until they have rendered all eastern Europe Slavic from the Arctic Ocean to the Adriatic and Ægean Seas. Only at one place is the continuity of Slavdom broken; but this interruption is sufficient to set off the Slavs into two distinct groups at the present day. The northern one, of which we have already treated,* consists of the Russians, Poles, Czechs, and Slovaks. The southern group, now before us, comprises the main body of the Balkan peoples from the Serbo-Croatians to the Bulgars, as shown upon the accompanying map. Between these two groups of Slavs—and herein is the significant point—is a broad belt of non-Slavic population, composed of the Magyars, linguistically now as always Finns; and the Roumanians, who have become Latin in speech within historic times. This intrusive, non-Slavic belt lies along or near the Danube, that great highway over which eastern peoples have penetrated Europe for centuries. The presence of this water way is distinctly the cause of the linguistic phenomenon. Rome went east; and the Finns, like the Huns, went west along it, with the result as described. Linguistically speaking, therefore, the boundary of the southern Slavs and that of the Balkan Peninsula, beginning, as we have said, at the Danube, are one and the same.

* Popular Science Monthly, October, 1898.

We may best begin our ethnic description by the apportionment of the entire Balkan Peninsula into three linguistic divisions, viz., the Greeks, the Slavs, and the Tatar-Turks. Of these the second is numerically the most important, comprising the Serbo-Croatians, the Albanians, and, in a measure, the Bulgarians. Their distribution is manifested upon our map, to which we have already directed attention. These Slavic-speaking peoples form not far from half the entire population. Next in order come the Greeks, who constitute probably about a third of the total. As our map shows, this Greek contingent is closely confined to the seacoast, with the exception of Thessaly, which, as an old Hellenic territory, we are not surprised to find Greek in speech to-day. The Slavs, contrasted with the Greeks, are primarily an inland population; the only place in all Europe, in fact, where they touch the sea is along the Adriatic coast. Even here the proportion of Greek intermixture is more considerable than our map would seem to imply. The interest of this fact is intensified because of the well-deserved reputation as admirable sailors which the modern Dalmatians possess. They are the only natural navigators of all the vast Slavic world. Everywhere else these peoples are noted rather for their aptitude for agriculture and allied pursuits. There is still another important point to be noted concerning the Greeks. They form not only the fringe of coast population in Asiatic as well as in European Turkey; they, with the Jews, monopolize the towns, devoting themselves to commerce as well as navigation. Jews and Greeks are the natural traders of the Orient. Thus is the linguistic segregation between Greek and Slav perpetuated, if not intensified, by seemingly natural aptitudes.

Perhaps the most surprising feature of our map of Turkey is the relative insignificance of the third element, the Turks. There were ten years ago, according to Couvreur, not above seven hundred and fifty thousand of them in all European Turkey. Bradaska estimated that they were outnumbered by the Slavs seven to one. Our map shows that they form the dominant element in the population only in eastern Bulgaria, where they indeed constitute a solid and coherent body. Everywhere else they are disseminated as a small minority among the Greeks or Slavs. Even about Constantinople itself the Greeks far outnumber them. In this connection we must bear in mind that we are now judging of these peoples in no sense by their physical characteristics, but merely by the speech upon their lips. Nowhere else in Europe, as we shall soon see, is this criterion so fallacious as in the Balkan states. Religion enters also as a confusing element. Sax's original map, from which ours is derived, distinguishes these religious affiliations as well as language. He was indeed the first to employ this additional test. The maze of tangled languages and religions upon his map proved too complicated for our imitative abilities. We were obliged to limit our cartography to languages alone. The reader who would gain a true conception of the ethnic heterogeneity of Turkey should consult his original map.

The word Turk was for several centuries taken in a religious sense as synonymous with Mohammedan,* as in the Collect for Good Friday in its reference to "Jews, Turks, infidels, and heretics." Thus in Bosnia, where in the fifteenth century many Slavs were converted to Mohammedanism, their descendants are still known as Turks, especially where they use the Turkish speech in their religion. Obviously in this case no Turkish blood need flow in their veins. It is the religion of Islam, acting in this way, which has served to keep the Turks as distinct from the Slavs and Greeks as they are to-day. Freeman has drawn an instructive comparison in this connection between the fate of the Bulgars, who, as we shall see, are merely Slavonized Finns, and the Turks, who have steadily resisted all attempts at assimilation. The first came, he says, as "mere heathen savages (who) could be Christianized, Europeanized, assimilated," because no antipathy save that of race and speech had to be overcome. The Turks, in contradistinction, came "burdened with the half-truth of Islam, with the half-civilization of the East." By the aid of these, especially the former, the Turk has been enabled to maintain an independent existence as "an unnatural excrescence" on this corner of Europe.

Even using this word as in a measure synonymous with religious affiliations, the Turks form but a small and decreasing minority in the Balkan Peninsula. Couvreur affirms that not over one third of the population profess the religion of Islam, all the remainder being Greek Catholics. This being so, the query at once suggests itself as to the reason for the continued political domination of this Turkish minority, Asiatic alike in race, in speech, and in religion. The answer is certain. It depends upon that subtle principle, the balance of power in Europe. Is it not clear that to allow the Turk to go under, as numerically he ought to do, would mean to add strength to the great Slavic majority, affiliated as it is with Russia both by speech and religion? This, with the consent of the Anglo-Saxon and other Teutonic rivals of the Slav, could never be allowed. Thus does it come about that the poor Greek is ground between the upper Turkish and the nether Slavic millstone. "Unnatural disunion is the fate of the whole land, and the cuckoo-cry about the independence and integrity of the Ottoman Empire means, among the other evil things that it means, the continuance of this disunion." Let us turn from this

* Consult Taylor, 1890, p. 48; Von Luschan, 1889, p. 198; Sax, 1863, p. 97.

distressing political spectacle to observe what light, if any, anthropology may shed upon the problem.

From the relative isolation of the Greeks at the extreme southern point of the peninsula and especially in the Peloponnesus, it would seem that they might be relatively free from those ethnic disturbances which have worked such havoc elsewhere in the Orient. Nevertheless, Grecian history recounts a continuous succession of inroads from the landward north, as well as from the sea. It would transcend the limits of our study to attempt any detailed analysis of the early ethnology of the country.* Examination of the relationship of the Pelasgi to their contemporaries we leave to the philologists. Positively no anthropological data on the matter exist. We are sufficiently grateful for the hundred or more well-authenticated ancient Greek crania of any sort which remain to us. It is useless to attempt any inquiry as to their more definite ethnic origin within the tribal divisions of the country.† The testimony of these ancient Greek crania is perfectly harmonious. All authorities agree that the ancient Hellenes were decidedly long-headed, betraying in this respect their affinity to the Mediterranean race, which we have already traced throughout southern Europe and Africa.‡ Whether from Attica; from Schliemann's successive cities excavated upon the site of Troy; or from the coast of Asia Minor; at all times from 400 B. C. to the third century of our era; it would seem proved that the Greeks were of this dolichocephalic type. Stephanos gives the average cranial index of them all as about 75.7, betokening a people like the present Calabrians in head form; and, for that matter, about as long-headed as the Anglo-Saxons in England and America. More than this concerning the physical traits of these ancient Greeks we can not establish with any certainty. No perfect skeletons from which we can ascertain their statures remain to us. Nor can we be more positive as to their brunetness. Their admiration for blondness in heroes and deities is well known. As Dr. Beddoe ('93) says, almost all of Homer's favorites were blond or chestnut-haired, as well as large and tall. Lapouge # seems inclined to regard this as proof that the Greeks themselves were of this type, a deduction which appears to us in no wise well founded. ‖ As we shall see, every characteristic in their modern descendants and

* Consult Fligier, 1881. Stephanos, 1884, p. 430, gives a complete bibliography of the older works. Cf. also Reinach, 1893 b, in his review of Hesselmeyer; and on the supposed Hittites, the works of Wright, De Cara, Conder, etc.

† Stephanos, 1884, p. 432, asserts the Pelasgi to have been brachycephalic, while Zampa, 1886 b, p. 639, as positively affirms the contrary view.

‡ Nicolucci, 1865 and 1867; Zaborowski, 1881; Virchow, 1882 and 1893; Lapouge, 1896 a, pp. 412–419; and Sergi, 1895 a, p. 75, are best on ancient Greek crania.

1896 a, p. 414.

‖ Stephanos, 1884, p. 439.

every analogy with the neighboring populations leads us to the conclusion that the classical Hellenes were distinctly of the Mediterranean racial types, little different from the Phœnicians, the Romans, or the Iberians.

Since the Christian era, as we have said, a successive downpour of foreigners from the north into Greece has ensued.* In the sixth century came the Avars and the Slavs, bringing death and disaster. A more potent and lasting influence upon the country was probably produced by the slower and more peaceful infiltration of the Slavs into Thessaly and Epirus from the end of the seventh century onward. A result of this is that Slavic place names to-day occur all over the Peloponnesus in the open country where settlements could readily be made. The most important immigration of all is probably that of the Albanians, who, from the thirteenth century until the advent of the Turks, incessantly penetrated the land. As a result the Albanian language is spoken to-day over a considerable part of the Peloponnesus, especially in its northeastern corner, where it attaches to the mainland. Only one little district has preserved, it may be added, anything like the original classical Greek speech. The Tzakons, in a little isolated and very rugged district on the eastern coast, include a number of classical idioms in their language. Everywhere else, either in the names of rivers, mountains, and towns, or in borrowed words, evidence of the powerful influence of the Slavic infiltration occurs. This has induced Fallmerayer, Philippson, and others to assert that the Slavs have in fact submerged the original Greeks entirely.† Explicit rebuttal of this is offered by Hopf, Hertzberg, and Tozer, who admit the Slavic element, but still declare the Greeks to be Greek. This is a matter concerning which neither philologist nor geographer has a right to speak; the anthropological testimony is the only competent one. To this we turn.

The modern Greeks are a very mixed people. There can be no doubt of this fact from a review of their history. In despite of this, they still remain distinctly true to their original Mediterranean ancestry. This has been most convincingly proved in respect of their head form.‡ The cephalic index of modern living Greeks ranges with great constancy about 81. This, it should be observed, betokens an appreciably broader head than in the case of the ancient Hellenes. Stephanos, who has measured several hundred recruits, finds dolicho-

* Philippson, Zur Ethnographie des Peloponnes. Petermann, xxxvi, 1890, pp. 1–11, 33–41, with map, gives a good outline of these. Consult also Stephanos, 1884, pp. 422 *et seq.*

† Cf. Couvreur, 1890, p. 514; and Freeman, 1877 d, p. 401.

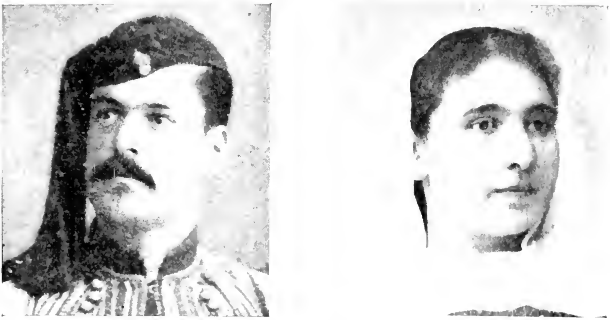
‡ Weisbach, 1882; Nicolucci, 1867; Apostolides in Bull. Soc. d'Anth., 1883, p. 614; Stephanos, 1884; Neophytos, 1891; Lapouge, 1896 a, p. 419. Von Luschan, 1889, p. 209, illustrates the similarity between the Greek and the Bedouin skull.

cephaly to be most prevalent in Thessaly and Attica; while broad-headedness, so characteristic, as we shall see, of the Albanians and other Slavs, is more accentuated toward the north, especially in Epirus. About Corinth also, where Albanian intermixture is common, the cephalic index rises above 83. The Peloponnesus has probably best preserved its early dolichocephaly, as we should expect. In Thessaly alone are the modern Greeks as purely Mediterranean as in classic times. There can be no doubt that in Asia Minor at least, the word Greek is devoid of any racial significance. It merely denotes a man who speaks Greek, or else one who is a Greek Catholic, converted from Mohammedanism. Greek, like Turk, has become entirely a matter of language and religion, as these people have intermingled. Thus in the southwest of Asia Minor, where Semitic influences have been strong, von Luschan * makes the pregnant observation that the Greeks, in the main, look like Jews and speak Turkish. Here, then, is proof positive that no Greeks of pure Mediterranean descent remain to represent the primitive Hellenic type in that region. But it is equally certain that in the main body of the Greeks at home in Greece, the original racial traits are still in the ascendant. The smoothly oval and long faces in our two Greek portraits are surely of Mediterranean type. To this, the ideal form, the purest elements in the nation still tend to revert.

Whatever may be thought of the ancients, the modern Greeks are strongly brunet in all respects. Ornstein ('79) found less than ten per cent of light hair, although blue and gray eyes were characteristic of rather more than a quarter of his seventeen hundred and sixty-seven recruits. This accords with expectation, for among the Albanians, next neighbors and most intrusive aliens in Greece, light eyes are quite common. Weisbach's ('82) data confirm this, ninety-six per cent of his Greeks being pure brunets.† In stature these people are intermediate between the Turks and the Albanians and Dalmatians, which latter are among the tallest of Europeans. In facial features Nicolucci's early opinion seems to be confirmed, that the Greek face is distinctively orthognathous—that is to say, with a vertical profile, the lower parts of the face being neither projecting nor prominent. The face is generally of a smooth oval, rather narrow and high, especially as compared with the round-faced Slavs. The nose is thin and high, perhaps more often finely chiseled and straight in profile. The facial features seem to be well demonstrated in the classic statuary, although it is curious, as Stephanos observes, that these ideal heads are distinctly brachycephalic. Either the ancient sculptors knew little of

* 1889, p. 209.

† Neophytos finds 82.5 per cent of dark-brown or black hair, only five per cent blond or red; while seventeen per cent of the eyes were dark among two hundred individuals.



GREEKS.

ROUMANIANS. County Hunyad, Hungary.

BULGARIANS. County Temes, Hungary.

BALKAN STATES.

anthropology, or else we have again a confirmation of our assertion that, however conscious of their peculiar facial traits a people may be, the head form is a characteristic whose significance is rarely recognized.

Linguistically the pure Slavs in the Balkan states comprise only the Serbo-Croatians and the Albanians (see map), dividing between them the ancient territory of Illyria. This western half of the peninsula, rugged and remote, has been relatively little exposed to the direct ravages of either Finnic or Turkish invaders. Especially is this true of Albania. Nearly all authorities since Hahn are agreed in identifying these latter people—who call themselves Skipetars, by the way —as the modern representatives of the ancient Illyrians. They are said to have been Slavonized by the Serbo-Croatians, who have been generally regarded as descendants of the settlers brought by the Emperor Heraclius from beyond the Save. This he is said to have done in order to repopulate the lands devastated by the Avars and other Slavs who, Procopius informs us, first appeared in this region in the sixth century of our era. The settlers imported by Heraclius came, we are told, from two distant places: Old Servia, or Sorabia, placed by Freeman in modern Saxony; and Chrobatia, which, he says, lies in southwestern Poland. According to this view, the Serbo-Croatians are an offshoot from the northern Slavs, being divided from them to-day by the intrusive Hungarians, while the Albanians alone are truly indigenous to the country.

The recent political fate of these Illyrian peoples has been quite various, the Albanians alone preserving their independence continually under the merely nominal rule of the Turks. Religion, also, has affected these Slavs in various ways. Servia owes much of its present peace and prosperity to the practical elimination of the Moslems. Bosnia is still largely Mohammedan, with about a third of its people, according to White ('86), still professing that religion. The significance of this is increased, since it was mainly the upper classes in Bosnia, according to Freeman, who embraced the religion of Islam in order to preserve their power and estates. The conversion was not national, as in the case of the Albanians. Thus social and religious segregation work in harmony to produce discord. With multitudes of Jews monopolizing the commerce of the country and the people thus divided socially as well as in religion, the political unrest in Bosnia certainly seems to require the strong arm of Austrian suzerainty to preserve order.

Whatever the theory of the historians as to origins may be, to the anthropologist the modern Illyrians—Serbo-Croatians and Albanians alike—are physically a unit. Two characteristics render this ethnic group distinctive: first, that it comprises some of the tallest men in the world, comparing favorably with the Scotch in this respect; and, secondly, that the Illyrians tend to be among the broadest-headed people known. In general, it would appear that the people of Herzegovina and northern Albania possess these traits to the most notable degree, while both in the direction of the Save and Danube and of the plains of Thessaly and Epirus they have been attenuated by intermixture. Presumably also toward the east among the Bulgarians in Macedonia and Thrace these characteristics diminish in intensity. Thus, for example, while the Herzegovinians, measured by Weisbach, yielded an average stature of five feet nine inches, the Bosnians were appreciably shorter; and the Dalmatians and Albanians were even more so. Nevertheless, as compared with the Greeks, Bulgars, Turks, or Roumanians, even the shortest of these Slavs stood high. From this specific center outward, especially around the head of the Adriatic Sea, over into Venetia, spreads the influence of this giantism. It confirms, as we have said, the classical theory of an Illyrian cross among the Venetians, extending well up into the Tyrol.

As for the second trait, the exaggerated broad-headedness, it too, like the tallness of stature, seems to center about Herzegovina and Montenegro. Thus at Scutari, in the corner of Albania near this last-named country, Zampa * found a cranial index of 89; in Herzegovina the index upon the living head ranges above 87. It would be difficult to exceed this brachycephaly anywhere in the world. The square foreheads and broad faces of the people correspond in every way to the shape of the heads. Its significance appears immediately on comparison with the long oval faces of the Greeks.

One more trait of the Balkan Slavs remains for us to note. The people are mainly pure brunets, as we might expect, but they seem to be less dark than either the Greeks or the Turks. Especially among the Albanians are light traits by no means infrequent. In this respect the contrast with the Greeks is apparent, as well as with the Dalmatians along the coast and the Italians in the same latitude across the Adriatic. Weisbach found nearly ten per cent of blond and red hair among his Bosnian soldiers, while about one third of the eyes were either gray or blue. The Herzegovinians are even lighter than the Bosnians, almost as much so as the Albanians. From consideration of these facts it would appear as if the harsh climate of these upland districts had been indeed influential in setting off the inland peoples from the Italian-speaking Dalmatians along the coast. For among the latter brunetness certainly increases from north to south, conformably to the general rule for the rest of Europe. In the interior, blondness apparently moves in the contrary direction, cul-

* 1886 b, p. 637.

minating in the mountain fastnesses of northern Albania and the vicinity. On the whole, we find also in this trait of brunetness competent evidence to connect these Illyrians with the great body of the Alpine race farther to the west. We have another illustration of its determined predilection for a mountainous habitat, in which it stoutly resists all immigrant tendencies toward variation from its primitive type.

The Osmanli Turks, who politically dominate the Balkan Peninsula, notwithstanding their numerical insignificance, are mainly distinctive among their neighbors by reason of their speech and religion. Turkish is the westernmost representative of a great group of languages, best known, perhaps, as the Ural-Altaic family.* This comprises all those of northern Asia even to the Pacific Ocean, together with that of the Finns in Russian Europe. Its members are by no means unified physically. All varieties of type are included within its boundaries, from the tall and blond one which we may call Finnic, prevalent about the Baltic; to the squat and swarthy Kalmucks and Kirghez, to whom we have in a physical sense applied the term Mongols. The Turkish branch of this great family of languages is to-day represented in eastern Europe by two peoples, whom we may roughly distinguish as Turks and Tatars.† The term Tatar, it should be observed, is entirely of European invention, like the similar word Hungarian. The only name recognized by the Osmanli themselves is that of Turk. This, by the way, seems quite aptly to be derived from a native root meaning "brigand," according to Chantre. They apply the word Tatar solely to the north Asiatic barbarians. By general usage this latter term, Tatar, has to-day become more specifically applied by ethnologists to the scattered peoples of Asiatic descent and Turkish speech who are mainly to be found in Russia and Asia Minor.

Of the two principal physical types to-day comprised within the limits of the Ural-Altaic languages, the Turks and Tatars seem to be affiliated with the Mongol rather than the Finn, not physically alone, but in respect of language as well. As a matter of fact, they are racially nearer the Aryan-speaking Europeans than most people imagine, in everything except their speech. Their nearest relatives in Asia seem to be the Turkoman peoples, who, to the number of a million or more, inhabit the deserts and steppes of western Asia. It was from somewhere about this latter region, as we know, that the hordes of the

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* Vambéry, 1885, divides the Ural-Altaic family into five groups—viz., (1) Samoyed, (2) Tungus, (3) Finnic, (4) Mongolic, (5) Turkish or Tatar.

† On terminology consult Vambéry, 1885, p. 60; Chantre, 1895, p. 199; Keane, 1897, p. 302.

Uzbeg. Ferghanah.

Kiptchak.

Kara-Kirghez.

Turkoman Types.

Huns under Attila, and those of Genghis Khan and Tamerlane, set forth to the devastation of Europe. The physical type of these inhabitants of Turkestan has been fairly well established by anthropologists. It persists throughout a great multitude of tribes of various names, among whom the Kara-Kirghez, Uzbegs, and Kiptchaks are prominent.* On page 625 we have portraits of these Turkoman types. The most noticeable feature of the portraits is the absence of purely Mongol facial characteristics. Except in the Kara-Kirghez the features are distinctly European. There is no squint-eye; the nose is well formed; the cheek bones are not prominent, although the faces are broad; and, most important of all, the beard is abundantly developed, both in the Uzbeg and the Kiptchak. The Kara-Kirghez, on the other hand, betrays unmistakably his Mongol derivation in every one of these important respects. One common trait is possessed by all three—to wit, extreme brachycephaly, with an index ranging from 85 to 89. The flatness of the occiput is very noticeable in our portraits in every case, giving what Hamy calls a "cuboid aspect" to the skull. These portraits, if typical, should be enough to convince us that the Turkoman of the steppes about the Aral and Caspian Seas is far from being a pure Mongol even in his native land, although a strain of Mongol blood is apparent in many of their tribes.

The fact is that the Asiatic Turkomans, whence our Osmanli Turks are derived, are a highly composite type. A very important element in their composition is that of certain brachycephalic peoples of the Pamir, the Galchas and mountain Tadjiks. These are for all practical purposes identical with the Alpine type of western Europe. In their accentuated brachycephaly, their European facial features, their abundance of wavy hair and beard, and finally in their intermediate color of hair and eyes,† these latter peoples in the Pamir resemble their European prototypes, or perhaps we had better say, congeners. So close is this affiliation that the occurrence of this type in western Asia is the keystone in any argument for the Asiatic origin of the Alpine race of Europe. The significance of it for us in this connection is that it explains the European affinity of many of the Turkoman tribes, who are more strongly European than Mongol in their resemblances. It is highly important, we affirm, to fix this in mind, for the prevalent opinion seems to be that the Turks in Europe have departed widely from their ancestral Asiatic type, because of their present lack of Mongol characteristics, such as almond eyes, lank black hair, flat noses, and high cheek bones.

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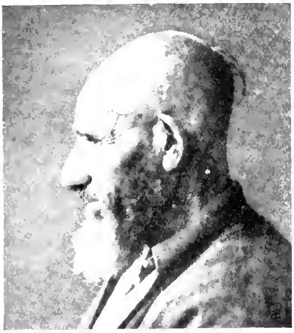
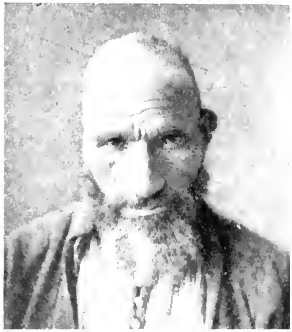
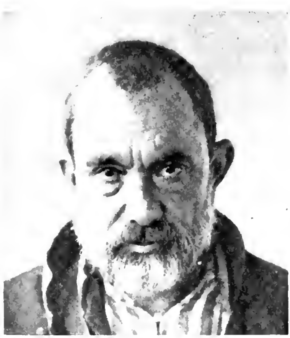
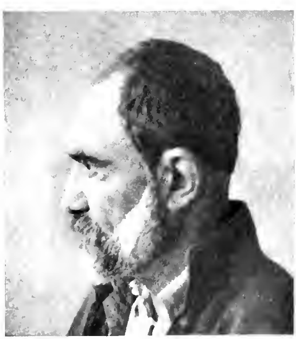
* Complete data on these people will be found in Ujfalvy, 1878–'80, iii, pp. 7–50; Les Aryens, etc., 1896, pp. 385–434; Bogdanof, 1888; Yavorski, 1897.

† Ujfalvy (Les Aryens, etc., 1896, p. 428) found chestnut hair most frequent, with twenty-seven per cent of blondness, among some of the Tadjiks. The eyes are often greenish gray or blue (Ujfalvy, 1878–'80, iii, pp. 23–33, tables).

Nomad Iververk. Lycia, Asia Minor.


Turk. Lycia, Asia Minor.

Turk. Lycia, Asia Minor.

Turks.

Either the Osmanli Turks were never Mongols, or they have lost every trace of it by intermixture. Our portraits on the opposite page give little indication of Asiatic derivation except in their accentuated short- and broad-headedness. This is considerably more noticeable in Asia Minor than in European Turkey.* West of the Bosporus the Turks differ but little from the surrounding Slavs in head form. They have been bred down from their former extreme brachycephaly, which still rules to a greater degree in Asia Minor. In our portraits from this region the absence of occipital prominence is very marked. In addition to this, the Turks are everywhere, as Chantre observes, "incontestably brunet." The hair is generally stiff and straight. The beard is full. This latter trait is fatal to any assumption of a persistence of Kirghez blood, or of any Mongolic extraction, in fact. The nose is broad, but straight in profile. The eyes are perfectly normal, the oblique Mongol type no more frequent than elsewhere. In stature tallness is the rule, judging by Chantre's data, but in this respect social conditions are undoubtedly of great effect. On the whole, then, we may consider that the Turks have done fairly well in the preservation of their primitive characteristics. Chantre especially finds them quite homogeneous, considering all the circumstances. They vary according to the people among whom their lot is cast. Among the Armenians they become broader-headed, while among the Iranian peoples—Kurds or Persians—the opposite influence of intermixture at once is apparent.

The Bulgarians are of interest because of their traditional Finnic origin and subsequent Europeanization. This has ensued through conversion to Christianity and the adoption of a Slavic speech. Our earliest mention of these Bulgars would seem to locate them between the Ural Mountains and the Volga.† The district was, in fact, known as Old Bulgaria till the Russians took it in the fifteenth century. As to which of the many existing tribes of the Volga Finns represent the ancestors of these Bulgarians, no one is, I think, competent to speak. Pruner Bey seems to think they were the Ostiaks and Voguls, since emigrated across the Urals into Asia; the still older view of Edwards and Klaproth made them Huns; Obédénare, according to Virchow, said they were Samoyeds or Tungus; while Howorth and Beddoe claim the honor for the Chuvashes. These citations are enough to prove that nobody knows very much about it in detail. All

* On the anthropology of European Turks, Weisbach, 1873, is the only authority. He found an average cephalic index of 82.8 in 148 cases. Elisyeef, 1890–'91, and Chantre, 1895, pp. 206–211, have worked in Anatolia, with indices of 86 for 143 individuals, and 84.5 for 120 men, respectively. Both von Luschan and Chantre give a superb collection of portrait types in addition.

† Read Pruner Bey, 1860 b; Howorth; Obédénare, and especially Kanitz, 1875, for historic details.

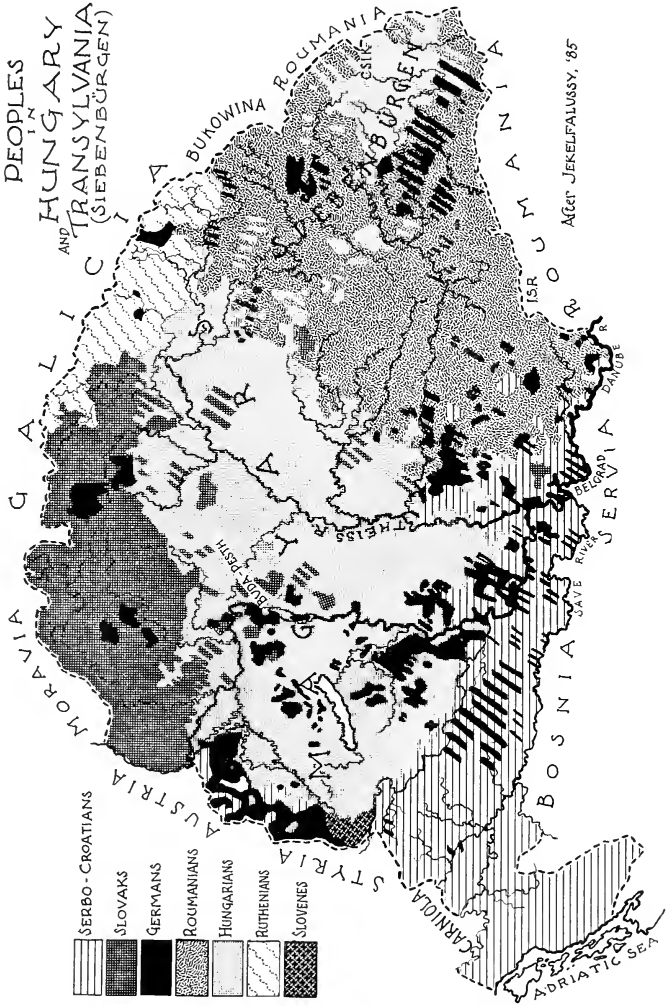
that can be affirmed is that a tribe of Finnic-speaking people crossed the Danube toward the end of the seventh century and possessed themselves of territory near its mouth. Remaining heathen for two hundred odd years, they finally adopted Christianity and under their great leaders, Simeon and Samuel, became during the tenth century a power in the land. Their rulers, styling themselves "Emperors of the Slavs," fought the Germans; conquered the Magyars as well as their neighbors in Thrace, receiving tribute from Byzantium; became allies of Charlemagne; and then subsided under the rule of the Turks. Since the practical demise of this latter power they have again taken courage, and in their semi-political independence in Bulgaria and northern Roumelia rejoice in an ever-rich and growing literature and sense of nationality.

Bulgarian is spoken, as our map at page 614 indicates, far outside the present political limits of the principality—indeed, over about two thirds of European Turkey. Gopčević has made a brilliant attempt to prove that Macedonia, shown by our map and commonly believed to be at bottom Bulgarian, is in reality populated mainly by Serbs.* The weakness of this contention was speedily laid bare by his critics. Political motives, especially the ardent desire of the Servians to make good a title to Macedonia before the disruption of the Ottoman Empire, can scarcely be denied. Servia needs an outlet on the Mediterranean too obviously to cloak such an attempted ethnic usurpation. As a fact, Macedonia, even before the late Greco-Turkish war, was in a sad state of anarchy. The purest Bulgarian is certainly spoken in the Rhodope Mountains; there are many Roumanians of Latin speech; the Greeks predominate all along the sea and throughout the three-toed peninsula of Salonica, while the Turks are sparsely disseminated everywhere. And as for religion—well, besides the severally orthodox Greeks and Turks, there are in addition the Moslem and apostate Bulgarians, known as Pomaks, who have nothing in common with their Greek Catholic fellow-Bulgars, together with the scattering Pindus Roumanians and Albanians in addition. This interesting field of ethnographic investigation is, even at this late day, practically unworked. As Dr. Beddoe writes—and his remarks are equally applicable to Americans—"here are fine opportunities for any enterprising Englishman with money and a taste for travel and with sufficient brains to be able to pick up a language. But, alas! such men usually seem to care for nothing but 'killing something.'"

The Roumanians, or Moldo-Wallachians, are not confined within the limits of that country alone. Their language and nationality cover not only the plains along the Danube and the Black Sea, but

* 1889 a, with map, in Petermann, 1889 b. Cf. criticism of his contention by Oppel, 1890; Couvreur, 1890, p. 523; and Ghennadieff, 1890, p. 663.

their speech extends beyond the Carpathian Mountains over the entire southeastern quarter of Hungary and up into the Bukovina. Transyl-



vania is merely a German and Magyar islet in the vast extent of the Roumanian nation. There are more than a third as many Roumanians as there are Magyars in the Hungarian kingdom, according to the census of 1890. Politically it thus happens that these people are pretty well split up in their allegiance. Nor can this condition be other than permanent. For the Carpathian Mountains, in their great circle about the Hungarian basin, cut directly through the middle of the nation as measured by language. This curious circumstance can be accounted for only on the supposition that the disorder in the direction of the Balkan Peninsula, incident upon the Turkish invasion, forced the growing nation to expand toward the northwest, even over the natural barrier interposed between Roumania proper and Hungary. Geographical law, more powerful than human will, ordains that this latter natural area of characterization—the great plain basin of Hungary—should be the seat of a single political unit. There is no resource but that the Roumanians should in Hungary accept the division from their fellows over the mountains as final for all political purposes.*

The native name of these people is Vlach, Wallach, or Wallachian. Various origins for the name have been assigned. Lejean asserts that it designates a nomad shepherd, in distinction from a tiller of the soil or a dweller in towns. Picot voices the native view as to ethnic origins by deriving the word Wallach from the same root as Wales, Walloon, etc., applied by the Slavs and Germans to the Celtic peoples as "foreigners." This theory is now generally discountenanced. Obédénare's attempt to prove such a Celtic relationship has met with little favor.† The western name Roumanian springs from a similarly exploded hypothesis concerning the Latin origin of these people. To be sure, Roumanian is distinctly allied to the other Romance languages in structure. It is an anomaly in the eastern Slavic half of Europe. The most plausible explanation for this phenomenon, and one long accepted, was that the modern Roumanians were descendants of the two hundred and forty thousand colonists whom the Emperor Trajan is said to have sent into the conquered province of Dacia. The earlier inhabitants of the territory were believed to have been the original Thracians. Since no two were agreed as to what the Thracians were like, this did not amount to much. Modern common sense has finally prevailed over attempts to display philological erudition in such matters. Freeman expresses this clearly. Roumania, as he says, lay directly in the pathway of all invasions from the East; the hold of the Romans upon Dacia was never firm; the province was the first to break away from the empire; and finally proof of a Latinization only at the late date of the thir-

* Auerbach, 1898, p. 286, gives a full summary of the rival controversy between Roumanians and Hungarians as to priority of title in Transylvania.

† Cf. Picot, 1883, in his review of Tocilescu; and Rosny, 1885, p. 83.

teenth century is not wanting. The truth seems to be that two forces were contending for the control of eastern Europe. The Latin could prevail only in those regions which were beyond the potent influence of Greece. Dacia being remote and barbarian, this Latin element had a fighting chance for survival, and succeeded.

Our ethnic map at page 614 shows a curious islet of Roumanian language in the heart of the Greek-speaking territory of Thessaly. There is little sympathy between the two peoples, according to Hellène. The occurrence of this Roumanian colony, so far removed from its base, has long puzzled ethnographers. Some believe the peoples were separately Romanized *in situ;* others that they were colonists from Dacia in the ninth and tenth centuries. At all events, these Pindus Roumanians are too numerous—over a million souls—to be neglected in any theory as to the origin of their language.* Another islet of quasi-Roumanian speech occurs in Istria, on the Adriatic coast. Its origin is equally obscure.†

It is no contradiction that, in spite of the fact of our exclusion of Roumania from the Balkan Peninsula owing to its Latin affinities, thereby seeming to differentiate it sharply from Bulgaria, the latter of Finnic origin; that we now proceed to treat of the physical characteristics of the two nationalities, Roumanian and Bulgarian, together. Here is another example of the superficiality of language, of social and political institutions. They do not concern the fundamental physical facts of race in the least. At the same time we again emphasize the necessity of a powerful corrective, based upon purely natural phenomena, for the tendency of philologists and ethnographers to follow their pet theories far afield, giving precedence to analogies of language and customs over all the potent facts of geographical probability. Let us look at it in this light. Is there any chance that, on the opposite sides of the Danube, a few Finns and a few Romans respectively interposed among the dense population which so fertile an area must have possessed, even at an early time, could be in any wise competent to make different types of the two? There is nothing in our confessedly scanty anthropological data to show it, at all events. We must treat the lower Danubian plain as a unit, irrespective of the bounds of language, religion, or nationality.

It was long believed that the Bulgarians were distinctive among the other peoples of eastern Europe by reason of their long-headedness. All the investigations upon limited series of crania pointed in that direction. This naturally was interpreted as a confirmation of the historic data as to a Finnic Bulgarian origin very distinct from that of the broad-headed Slavs. Several recent discoveries have put a new face upon the matter. In the first place, researches by Dr. Bassa-

* Picot, 1875, pp. 390 *et seq.*

† Auerbach, 1898, p. 211.

novitch, of Varna, upon several thousand recruits from western Bulgaria prove that in the west these Bulgarians even outdo many of the Balkan Slavs in their broad-headedness.* At the same time it appears that the older authorities were right, after all, in respect of the eastern Bulgarians. Among them, and also over in eastern Roumelia, long heads are still the rule. The oval-faced Bulgarians among our portraits are probably of this dolichocephalic type. Their contrast facially with the broad-headed Roumanians is very marked. Thus it is established that the Bulgarian nation is by no means a unit in its head form. We should add also that, although not definitely proved as yet, it is highly probable that similar variations occur in Roumania. In the Bukovina brachycephaly certainly prevails. Our square-faced Roumanians on page 621 may presumably be taken to represent this type. This broad-headedness decreases apparently toward the east as we leave the Carpathian Mountains, until along the Black Sea it seems, as in Bulgaria, to give way to a real dolichocephaly.†

How are we to account for the occurrence of so extended an area of long-headedness all over the great lower Danubian plain? Our study of the northern Slavs has shown that no such phenomenon occurs there among the Russians. It certainly finds no counterpart among the southern Slavs or the Turks. The only other people who resemble these Bulgars in long-headedness are the Greeks. Even they are far separated; and, in any event, but very impure representatives of the type. What shall we say? Two explanations seem to be possible, as Dr. Beddoe observes.‡ Either this dolichocephaly is due to the Finnicism of the original Bulgars, or else it represents a characteristic of the pre-Bulgarian population of the Danube basin. He inclines with moderation to the former view. The other horn of the dilemma is chosen by Anutchin # in a brilliant paper at the late Anthropological Congress at Moscow. According to his view—and we assent most heartily to it—this dolichocephaly along the Black Sea represents the last survival of a most persistent trait of the primitive inhabitants of eastern Europe. Referring again to our study of Russia,|| we would call attention to the occurrence of a similar long-headed race underlying all the modern Slavic population. We are able to prove also that such a primitive substratum occurs over nearly all Europe. It has been unearthed not far from here, for example, at Glasinac in Bosnia. When archæological research is extended

* 1891, p. 30. Dr. Bassanovitch has most courteously sent me a sketch map showing the results of these researches. Deniker, 1897, p. 203, and 1898 a, describes them also.

† Deniker, 1898 a, p. 122; Weisbach, 1877, p. 238; Rosny, 1885, p. 85.

‡ 1879, p. 233.

1893, p. 282.

|| Popular Science Monthly, October, 1898, p. 734.

farther to the east, new light upon this point may be expected. It will be asked at once why this primitive population should still lie bare upon the surface, here along the lower Danube, when it has been submerged everywhere else in Central Europe. Our answer is ready. Here in this rich alluvial plain population might, expectedly, be dense at a very early period. As we have observed before, such a population, if solidly massed, opposes an enormous resistance to absorption by new-comers. A few thousand Bulgarian invaders would be a mere drop in the bucket of such an aggregation of men. We are strengthened in this hypothesis that the dolichocephaly of the Danubian plain is primitive, by reason of another significant fact brought out by Bassanovitch.* Long-headedness is overwhelmingly more prevalent among women than among men. The former represent more often what Bassanovitch calls the "dolichocephalic Thracian type." The oval-faced Bulgarian woman among our portraits would seem to be one of these. Now, in our treatment of the Jews,† we have sought to illustrate the principle that in any population the primitive type persists more often in the women. The bearing of such a law in the case of the Bulgars would seem to be definite. Their long-headedness, where it occurs, must date from a far more remote period than the historic advent of the few thousand immigrants who have given the name Bulgaria to the country.

As for the other physical traits of the Bulgarians and Roumanians there is little to be added. It goes without saying that they are both deep brunets. Obédénare says the Roumanians are very difficult to distinguish from the modern Spaniards and Italians. This is probably true in respect of brunetness. The Oriental cast of features of our portraits, on the other hand, can not fail to attract attention. More than two thirds of Bassanovitch's nineteen hundred and fifty-five Bulgarians were very dark-haired. Light eyes were of course more frequent, nearly forty per cent being classed as blue or greenish. A few—about five per cent—were yellow or tawny-haired, these individuals being at the same time blue-eyed. This was probably Procopius's excuse for the assertion that the Bulgars were of fair complexion. He also affirmed that they were of goodly stature. This is not true of either the modern Roumanians or Bulgars. They average less than five feet five inches in height,‡ being considerably shorter than the Turks, and positively diminutive beside the Bosnians and

* 1891, p. 31. Women dolicho-, twenty-five per cent; meso-, forty-two per cent; brachy-cephalic, thirty per cent; while among men the percentages are 3, 16, and 81 ± per cent respectively.

† Popular Science Monthly, January, 1899, p. 350.

‡ Bassanovitch's series of 1,955 individuals averages only 1.638 metre. *Op. cit.*, p. 30. Auerbach, 1898, p. 259, gives an average of 1.63 metre for 880 Wallachians in Transylvania. Obédénare, 1876, p. 374, states brown eyes to be most frequent in Roumania.

other southern Slavs. The Bulgarians especially are correspondingly stocky, heavily boned and built. We may also affirm a real difference in temperament between the two nationalities, built up, as we assert, from the same foundation. The Wallachians are said to be more emotional and responsive; the Bulgarians inclined to heaviness and stolidity. Both are pre-eminently industrious and contented cultivators of the soil, with little aptitude for commerce, so it is said. We hesitate to pass judgment upon either in respect of their further aptitudes until fuller data can be provided than are available at the present time.

MARVELOUS INCREASE IN PRODUCTION OF GOLD.

By ALEXANDER E. OUTERBRIDGE, Jr.

THE increasing annual production of gold in the world is a matter of such far-reaching economic importance, not only in the financial affairs of nations, but also in their industrial progress and in their civilization, that a vast amount of patient study has been given by eminent statisticians to the subject, and much time expended in compiling, from various historical records and other sources of information, statistical data which can be confidently accepted as approximately correct, showing the annual production of the precious metal from the time of the discovery of America down to the present day.

A publication of the United States Treasury Department, issued in 1897, containing information respecting the production of precious metals, etc., gives statistical tables showing the annual production of gold in the world, commencing with the year 1493. The earlier records are taken from a table of averages for certain periods compiled by Dr. Adolph Soetbeer, and the later figures (from 1885 to 1896) are the annual estimates of the Bureau of the Mint. Other tables show the annual production of gold from the mines of the United States alone from 1845 to 1896, and it is from these official sources mainly that the information has been gathered for this article, supplemented, however, by a full and very interesting communication to the author from the Director of the Mint, giving the latest figures, not yet published, and containing the estimates and deductions of the director respecting the production of gold in the world in 1898. This information is so timely and valuable that the author is of the opinion that the courteous letter of the Director of the Mint in response to his inquiries, if appended to this article, may prove to be—like the postscript of a lady's correspondence—its most important feature.

Students of political economy are well aware of the fact that some theorists have maintained that the annual production of gold in the world (apart from the phenomenal discoveries in California about the middle of the century, which were of an ephemeral character) does not keep pace with the natural increase in trade requirements, if gold is to maintain its position as the standard measure of value and the universal medium of exchange. This theory, after having passed through the various stages of *pro* and *con* argument in academic theses, became the "war cry" of a political party in this country composed of heterogeneous elements in the community, all inspired with one common idea that the balance of power in commercial transactions had been destroyed by the overwhelming force of concentration of capital and the "cornering" of the visible supply of gold in the world by a few enormously wealthy bankers. It was shown that, while the average annual production of gold in the world in five years from 1855 to 1860 exceeded $134,000,000, there was a constant decline thereafter, so that the annual average during five years from 1881 to 1885 barely exceeded $99,000,000, according to official estimates; also that the annual gold product of the mines of the United States declined from a value of $65,000,000 in 1853 to $33,000,000 in 1892. Furthermore, although a rising tendency was observed in each subsequent year, the production from the mines of this country in 1894 was still under $40,000,000, as was shown by the statistics of the United States Treasury Department.

While admitting the general accuracy of these statements of fact, it is the purpose of this paper to endeavor to show that the conclusions drawn therefrom were entirely fallacious, because due cognizance was not taken of the wonderful progress that has been made in recent years in mining and metallurgical arts whereby countless millions of tons of ore containing gold in such a finely divided state, or in such a refractory condition, that it was formerly worthless (costing more to recover the gold than the value of the precious metal contained in the ore), have now rendered these low-grade ores the most stable sources of supply of gold. Metallurgists, having knowledge of these facts, have at various times during the past ten years predicted that a golden stream would soon begin to flow from these practically new and apparently inexhaustible sources; but the people at large were wholly incredulous, and they are now astounded at the magnitude of the production of gold in the world in the past two years; and more especially, perhaps, are they amazed at the increase of production in the United States, as shown by the official reports of the Director of the Mint.

The gold production of the world in 1897 amounted in value, according to the most reliable estimates, to more than $237,000,000, and in 1898 to more than $280,000,000; and it is the opinion of the

Director of the Mint that the final compilation of figures will show that the production was "somewhere between $290,000,000 and $300,000,000!"

Gold Production of the World.

COUNTRIES.	1897. Fine ounces	1897. Kilogrammes.	1897. Value.	1898. Fine ounces	1898. Kilogrammes.	1898. Value.
North America.						
United States......	2,774,935	84,870.5	$59,210,795	3,110,788	95,200.7	$64,300,000
Canada...........	299,467	9,164.0	6,190,000	686,502	22,071.1	14,190,000
Newfoundland.....	3,000	93.3	62,010	3,000	93.3	62,010
Mexico...........	344,498	10,715.0	7,121,189	365,032	11,354.0	7,668,866
Central America...	25,399	789.9	525,000	25,399	789.9	525,000
South America.						
Argentina........	15,235	473.8	314,907	15,235	473.8	314,907
Bolivia...........	3,144	98.0	65,000	3,144	98.0	65,000
Brazil............	70,732	2,200.0	1,462,120	84,633	2,591.0	1,750,000
Chile............	68,096	2,118.0	1,407,544	68,096	2,118.0	1,407,544
Colombia.........	188,679	5,868.7	3,900,000	188,679	5,868.7	3,900,000
Ecuador..........	6,430	199.9	132,900	6,430	199.9	132,900
Guiana (British)...	101,505	3,156.9	2,098,098	88,617	2,756.0	1,861,393
Guiana (Dutch)....	32,983	1,025 8	681,748	28,273	865.3	584,421
Guiana (French)...	59,859	1,861.7	1,237,310	66,593	2,038.0	1,376,477
Peru.............	5,787	180.0	119,628	5,787	180.0	119,628
Uruguay..........	6,880	214.0	114,600	6,880	214.0	114,600
Venezuela........	39,384	1,224.9	814,067	39,384	1,224.9	814,067
Europe.						
Austria-Hungary...	105,397	3,278.2	2,178,556	105,397	3,278.2	2,178,556
France...........	10,513	327.0	217,304	10,513	327.0	217,304
Germany.........	90,921	2,780.9	1,879,357	90,921	2,780.9	1,879,357
Italy.............	10,325	316.0	213,431	10,325	316.0	213,431
Norway..........	650	20.0	13,508	653	20.0	13,508
Russia...........	1,046,965	32,408.2	21,538,490	1,216,100	37,217.0	25,136,994
Sweden...........	3,702	133.3	76,524	3,702	133.3	76,524
Turkey...........	387	12.0	8,000	387	12.0	8,105
United Kingdom...	2,032	62.5	42,001	2,032	62.5	42,001
Asia.						
China........	321,296	9,992.8	6,641,190	321,296	9,992.8	6,641,190
India (British).....	353,147	10,983.4	7,299,554	369,018	11,479.3	7,753,150
Japan............	34,509	1,073.3	713,300	34,509	1,073.3	713,300
Korea............	34,918	1,086.0	721,765	34,918	1,086.0	721,765
Malay Peninsula...	25,000	777.6	516,750	25,000	777.6	516,750
Borneo...........	4,837	150.6	100,000	4,837	150.6	100,000
Africa.						
Witwatersrand....	2,511,544	78,112.6	51,913,607	3,554,746	108,790.0	73,476,600
Other districts, S. A. R.........	232,466	7,230.0	4,805,072	229,528	7,024.3	4,744,350
West Coast.......	24,276	755.0	501,793	24,276	742.9	501,793
Rhodesia.........	....	....	....	10,000	306.3	206,700
Madagascar.......	19,351	601.8	400,000	19,351	601.8	400,000
Australasia, 7 colonies...........	2,520,333	77,130.6	52,095,338	2,945,426	91,024.7	61,480,763
Totals........	11,399,475	351,486.2	$237,332,456	13,805,407	425,333.1	$286,218,954

The above table, showing the estimated production of gold from all parts of the world in 1897 and 1898, is abstracted from the Annual Statistical Number of the Engineering and Mining Journal (January 1, 1899), and, although these figures may differ somewhat from those of the Director of the Mint, and from the final compilations, they are believed to be not very far from truth.

It will be seen that the principal countries contributing to the grand total in both years were Africa, the United States of America, Australasia, Russia, Canada, Mexico, and India, the names being given in the order of the respective importance of these countries as gold producers in 1898.

It may surprise many readers to observe that India is placed at the foot of the list, for we are accustomed to associate India with gold, Mexico with silver, and Russia with platinum; and it may also prove a surprise to find that the contribution of the Klondike region, which has created such a great sensation, is so trifling as compared to the grand total. In 1897 the Klondike was credited with an output of less than $3,000,000, and in 1898 of a little over $10,000,000.

It will be observed in the estimates of the Government's agents (January 1, 1899) of the production of gold in the United States for 1898 (see the letter of the Director of the Mint, appended hereto) that the gold production of the State of Colorado was more than twice that of the Klondike region, and the production of California was nearly fifty per cent greater than that of the Klondike.

Other surprising facts crop out in studying in detail the increasing production of gold, more especially in the United States. For example, California has always been regarded as pre-eminently the gold-giving State, and until 1897 she led all the other States in the value of gold annually produced. Colorado, on the other hand, was equally famous as a silver-producing State, and while still holding this leading position she has actually passed California in the production of gold. Colorado has thus taken the lead over all the States in the production of gold and silver.

The output of gold in the United States in 1898 was more than twice that of 1890; and the production of gold in the world in 1898, at the lowest estimate, was much more than twice the estimated production in 1890. In the decade just prior to the California gold discoveries, in 1849, the average annual production in the world is estimated to have been less than $13,500,000. In the previous decade it was less than $10,000,000. Assuming these figures of Dr. Adolph Soetbeer (which are accepted by the nations of the world, and incorporated in many official documents) to be approximately correct, it appears that the estimated production of gold in the world in the first third of the present century was but little more than the production in the single year 1898!

It is, indeed, difficult to comprehend the full significance of these figures at a glance: the production of gold in the past five years has amounted to more than $1,100,000,000; and if production should increase during the next five years in anything like the ratio of the past five years, it may be that a new economic problem, the very antithesis of that alluded to in the commencement of this paper, may present itself for solution. At all events, the cry of the Populists and others that increasing scarcity of gold is the cause of much of the poverty and of other ills of mankind, must surely be drowned in the golden stream now flowing from all quarters of the globe, almost threatening to become a rushing torrent, dangerous to the stable foundations of the world's commerce. That this, however, fortunately is an imaginary danger will appear from the following arguments:

Modern gold-getting by scientific methods compels the permanent investment of an enormous amount of capital, and a moderate return only in dividend is looked for as a rule; thus the balance between acquisition and disbursement is likely to be maintained in the future.

One of the chief causes of the extraordinary increase of production in very recent years is to be found in the application of the "cyanide process" to the recovery of gold from "tailings." This process is also largely applied to obtaining gold from very low-grade ores, that, in some cases, contain an average of less than one quarter of an ounce of gold distributed throughout a ton of ore! At the present time there are about twenty-five cyanide plants in this country, and over forty in the Transvaal, where the process has received its greatest development.

Although the fact that cyanide of potassium would dissolve gold quite readily was known long ago, having been employed by Faraday in his experiments with thin films of transparent gold, and used very extensively in the making of solutions of gold for electroplating baths during fifty years past, the practical application of the solvent to obtaining gold from low-grade ores is less than ten years old.

In Utah there is a dry bed of an ancient lake, the floor of which may be said to be carpeted with gold; according to a recent report this bed of limestone, eight miles by ten, varying from twenty to forty feet in thickness, and containing gold in proportion running from six to twenty dollars per ton, is an "ideal ore" for treatment by the cyanide process. A number of cyanide mills are now working the deposit, all paying dividends, and it is said that the only limit to output is the capacity of the mills. It is estimated that there are "5,000,000,000 tons of ore in the district, containing $50,000,000,000 worth of gold!" Although this statement is startling, the estimate is not a wild guess, for the blanket of ore has been cut in many places; hundreds of samples have been taken from different depths, and in all cases the finely distributed gold has been found, apparently having been deposited from solution in a mineral water which formed the lake in prehistoric times.

A similar deposit of silver was found in New Mexico about twenty years ago and was christened the "Silver Lake" Mine. This was worked profitably until the great fall in price of silver made the operation a losing one. The "blanket" still contains millions of ounces of silver, and it is probable that cheaper methods of recovering the metal from the ore will be devised whenever the price of silver shall have fallen low enough to enable it to take its place among the so-called "economic" metals, having far wider application in the arts than have the precious metals. At present silver holds an unfortunate place "betwixt and between" the precious and the economic metals.

Twenty years ago aluminum was more valuable than silver is today, and its production was correspondingly limited. Last year the price was reduced to a point which so widely extended its use that the production increased from 1,900 pounds in 1888 to more than 5,000,000 in 1898.

Although the gold deposit in the Camp Floyd district in Utah already alluded to may actually contain several billions of dollars' worth of gold, it will cost some billions of dollars' worth of labor and capital to recover the precious metal and will consume much time in the process; so that there is little reason to fear that gold will become so plentiful on account of this discovery that it will cease to be regarded as a precious metal. About forty years ago the assayers of the United States Mint announced that the clay underlying the city of Philadelphia contained more gold than had been brought from California and Australia, and this remarkable statement has never been disproved or even questioned. The gold, however, still remains locked fast in the clay, and the value of the precious metal has not yet fallen in consequence of the announcement of this old discovery. At that time the idea of profitably recovering gold from low-grade ores had not been born, and it is an interesting fact to note that in California gold is now being obtained from clay (by hydraulic washing methods) in which there is but little more than the average proportion of gold to the ton that the assayers found in the clay under the streets of Philadelphia. This does not prove, however, that it will now pay to excavate under the streets of the Quaker City, and undermine the buildings in order to wash out this gold, and until Philadelphia shall be provided with a far more copious water supply the most sanguine or suave promoter of great undertakings would find it impossible to obtain subscriptions to any scheme to recover this fugitive gold, or even, perhaps, difficult to give away shares of stock to influential individuals either in or out of councils.

An impression has prevailed that the production of gold in South Africa attained its maximum point in 1897, and that thenceforth the annual output would be smaller. On account of this fear the "Kaffirs" (South African gold-mining stocks) suffered a decline in the London stock market some months ago, but the statistics showed that the output during the first half of 1898 was larger than in the previous half year, and in the latter months of the year the increase was even more pronounced.

In an address given before the Mining and Metallurgical Section of the Franklin Institute on Mining and Minting of Gold and Silver in November last, the writer said that the production of gold in South Africa in 1898 would not fall far short of $70,000,000, and would probably be nearer $80,000,000. The estimate of the Director of the Mint fixes the amount almost at the latter figure. The United States, in spite of the considerable increase over 1897, takes second place as a world's producer of gold, Africa having contributed in 1898 an amount equal to that of the United States and Canada (including the Klondike) combined.

The startling announcements of discoveries of virgin gold in the Klondike and of rich placer gold deposits in other localities have had little to do with the enormous increase in production of gold in the world in recent years, though formerly such discoveries constituted the main source of supply of the precious metal. Digging for nuggets is a lottery pure and simple, in which a few prizes are obtained and many losses are suffered. It is said that for every dollar in gold taken out of the Klondike to date, two dollars have been carried in, and this is perhaps a conservative estimate. In fact, it is easy to prove by figures, if the value of labor be counted even at the lowest wage rate, say one dollar per diem, that far more money has been lost by the many gold-seekers than has been gained by the few fortunate ones in this twentieth-century search for the golden fleece.

The business of extracting gold from low-grade ores by scientific methods on a large scale, where the precious metal is evenly distributed throughout the matrix or gangue, is a legitimate field for the investment of capital, because the element of chance is reduced to a minimum, and even may be eliminated altogether. The margin of profit per ton of ore is not large as a rule in these operations, and thus the stability of value of the product is assured, whatever the output may be.

"TREASURY DEPARTMENT, BUREAU OF THE MINT,
"WASHINGTON, D. C., *February 1, 1899.*

"*Alexander E. Outerbridge, Jr., Philadelphia, Pennsylvania.*

"SIR: In answer to the inquiries in your letter of January 31st, I take pleasure in sending you such information on the production of gold in the principal gold-producing countries in 1898 as is at this early day available, comparing it with the gold output of the same countries in 1897. And first of the United States:

"Inclosed you will find an estimate made by the agents of the bureau of the gold yield of the several States and Territories in 1898. The aggregate outturn was $65,782,667. It must be clearly borne in mind that this is only an *estimate*, not the ascertained actual production. In 1897 the gold product of the United States was $57,363,000. Assuming the estimate of the gold product of the United States in 1898 to be correct, there was an increase in the latter year over the gold yield of 1897, in round numbers, of $8,420,000.

"The gold product of the Witwatersrand in 1898 was 4,295,602 ounces crude, and of the whole of the South African Republic 4,555,009 ounces crude, representing a value of $79,801,025.

"As the gold product of the Transvaal in 1897 was $57,633,861, the increase in 1898 was $22,167,164. The figures here given are those published in all the leading papers interested in such matters in England and on the European continent. They are not, any more than the figures given below, official to the Bureau of the Mint.

"I have not yet seen any figures of the total gold product of Australia in 1898, but the output of five out of the seven colonies has been published. The figures are as follows:

	1897. Ounces crude.	1898. Ounces crude.
New South Wales	292,217	341,722
New Zealand	251,645	280,176
Queensland	805,928	918,100
Victoria	812,765	837,258
West Australia	674,994	1,050,183
Total	2,837,549	3,527,439
		2,837,549
		689,890

"There was an increase in the gold product of these five colonies of $13,107,910, the ounce crude averaging about $19 in value. The total gold product of Australia in 1898 was, as I estimate it, about $67,792,000. In 1897 it was $55,684,182. As yet no figures of the gold output of the two Australian colonies—Tasmania and South Australia—have come under my observation.

"Persons not connected with the bureau, but whose opinions are entitled to respect, have estimated the increase in India's gold output in 1898 at about $500,000, and in that of Canada (including the Klondike) at $8,000,000. I have thus far no data on which to predicate an increase or decrease in the gold yield of Russia. The product of these last-mentioned countries in 1897 was:

India	$7,247,500
Canada	6,027,100
Russia	23,245,700

"The increase in the principal countries mentioned above, of their gold product in 1898 over 1897, reduced to a table, gives a total of $52,195,000, as follows:

United States	$8,420,000
South African Republic	22,167,000
Australia	13,108,000
Canada	8,000,000
India	500,000
Total	$52,195,000

"The world's product in 1897 was $237,504,800. In 1898 it will probably not be less than $289,699,800. My opinion is that it will be somewhere between $290,000,000 and $300,000,000.

"If any further information reaches me within a week or two, I shall be glad to communicate it to you.

"Respectfully yours,

"GEORGE E. ROBERTS, *Director of the Mint.*"

Agents' Estimate, January 1st, of the Production of Gold in the United States for 1898.

States and Territories.	Gold.
Alaska	$2,039,930
Arizona	3,185,490
California	14,883,721
Colorado	24,500,000
Idaho	2,273,902
Michigan	65,000
Montana	5,209,302
Nevada	2,959,731
New Mexico	360,000
Oregon	1,343,669
South Dakota	5,841,406
Texas	7,500
Utah	2,170,543
Washington	599,483
Wyoming	5,168
South Appalachian States	337,832
Total	$65,782,677

THE CALIFORNIA PENAL SYSTEM.

By CHARLES HOWARD SHINN.

THEORETICALLY every new commonwealth in organizing its institutions can measurably avoid the errors of older communities, and can venture upon promising experiments elsewhere untried. In practice, however, new States are usually compelled to face unforeseen difficulties, and although their various departments gain something in flexibility, they lose in systematic organization. They have the faults as well as the virtues of the pioneer.

Penology, like every other department of human thought, is a battlefield of opposing principles. But I know of nothing in print more inspiring to the officers of the State engaged in prison and reform work than Herbert Spencer's Essay on Prison Ethics. It is likely that many of the people who should read it are not aware of its value and interest to themselves. Beginning at the foundations, Mr. Spencer makes a lucid exposition of the necessity of "a perpetual readjustment of the compromise between the ideal and the practicable in social arrangements." As he points out, gigantic errors are always made when abstract ethics are ignored.

If society has the right of self-protection, it has, as Mr. Spencer asserts, the right to coerce a criminal. It has authority to demand restitution as far as possible, and to restrict the action of the offender as much as is needful to prevent further aggresssions. Beyond this point absolute morality countenances no restraint and no punishment. The criminal does not lose all his social rights, but only such portion of those rights as can not be left him without danger to the welfare of the community.

But absolute morality also requires that while living in durance the offender must continue to maintain himself. It is as much his business to earn his own living as it was before. All that he can rightfully ask of society is that he be given an opportunity to work, and to exchange the products of his labor for the necessaries of life. He has no right to eat the bread of idleness, and to still further tax the community against which he has committed an aggression. "On this self-maintenance equity sternly insists." If he is supported by the taxpayers the breach between himself and the true social order is indefinitely widened.

Such principles as these could easily have been made a fundamental part of the California prison system when the State was organized, for the famous Code of Reform and Prison Discipline, prepared about 1826 by a New Orleans lawyer, Edward Livingston, was well known to some of the ablest men of pioneer California, and a strong effort was made to obtain its adoption in complete form. That remarkable code known as the Livingston system agrees with the Spencerian principles of ethics, and has been a source of inspiration for the most advanced penal legislation of recent years. Louisiana adopted it only in part, but Belgium has the Livingston code in its entirety. California, suffering under difficult local conditions, took a course in the liberal pioneer days that has for a time rendered progress along the lines of modern development extremely difficult.

WARDEN W. E. HALE, of San Quentin.

California is a large and populous State, many portions of which are thinly settled and hard to reach. In early days it had many Spanish and Mexican outlaws, and became a refuge for criminals from all parts of the world. When the State was organized, money was extremely abundant, and every one had golden dreams. The idea of self-supporting prisons seemed absurd, not only because the rich young State seemed capable of supporting any expense, but also because no manufactures were yet established, and the most active penologist would have found it hard to find suitable employment for prisoners.

As time went on, the very strong labor unions of California, aided by many newspapers and politicians, accepted the principle that every dollar a convict earned was taken from some citizen, and that the State was bound to support its criminals in idleness. Numbers of good and earnest men in the service of the State as prison commissioners, wardens, and other officials studying methods elsewhere and mindful of local conditions, have made untiring efforts to stir the public conscience, and to gain recognition of a criminal's right to earn his own living by productive labor. As long ago as 1872 Hon. E. T. Crane, of Alameda County, chairman of a joint Assembly and Senate committee, made an excellent and progressive report on prison reforms. Something has been gained since then, and, though working under adverse conditions, the prisons have been excellently managed. But these results are due to individuals, not to the system, nor to the well-meant but often injurious enactments of legislatures meeting biennially for only sixty days.

Under the system of biennial State appropriations, nearly all institutions suffer at times from mistaken kindness, and at other times from undue parsimony. Since there is no general supervising board for the two State prisons and the two State reform schools, and no settled ratio of appropriation based upon the number of inmates, the friends of each institution naturally do their best to obtain as large appropriations as possible from each new legislature. Hence arise special visiting committees and combinations between legislators from different parts of the State to "take care of" institutions whose regular annual income should not be dependent in the least upon politics.

The appropriations made by the last two legislatures for all purposes connected with prisons and reform schools, including salaries of officials, are shown in the following table:

State Appropriations from July 1, 1895, to July 1, 1899 (Forty-seventh to Fiftieth Fiscal Years, inclusive).

Name of Institution.	Sum granted.	Average yearly grants.
San Quentin Prison	$615,153.40	$153,788.35
Folsom Prison	438,000.00	109,500.00
Preston School of Industry	237,000.00	59,250.00
Whittier State School	403,000.00	100,750.00
Transportation of prisoners	150,000.00	37,500.00
Totals	$1,843,153.40	$460,988.35

Some small appropriations for improvements are necessarily included in these totals, but nothing more than may be expected every year or two. It is proper to rate the average annual expense of these institutions at nearly half a million dollars, nor can this sum be materially reduced until the State accepts the fundamental principle that prisons should be made nearly or quite self-supporting.

San Quentin was once managed to some extent on the contract system. Furniture-makers and other manufacturers paid half a dollar a day for each convict employed, and at one time as many as eight hundred men were thus utilized, giving the prison an income of twenty-four hundred dollars a week. The system was so violently attacked by labor unions that it was finally abandoned, and now I am told that convict-made furniture, stoves, and other articles such as were formerly made at San Quentin are brought to California from Joliet, Illinois, and other places by the carload.

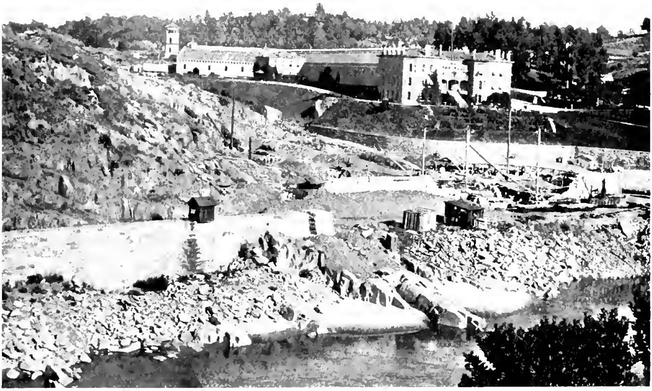
Having abandoned the contract system, the State decided to make jute bags, chiefly for grain, and to sell them as nearly as possible at cost direct to the consumers, so as to help the agricultural classes. Machinery costing $400,000 was obtained in England, and after many difficulties a factory was established at San Quentin. The price of raw material fluctuates greatly, and the mill has sometimes lost money, sometimes made a somewhat nominal profit. During the fiscal year ending June 30, 1891, for instance, 2,574,254 pounds of goods were manufactured at a total operating expense of $160,684.07, and were sold at a price which nominally gave $40,275.07 profit. But no sinking fund was allowed for, to cover wear and tear of machinery, nor did the operating expenses include even the maintenance of the convicts while at work. The following fiscal year the profit estimated in the same way was $39,293.18. During the fiscal year 1893–'94 the loss on the jute mill was $14,660.22; in 1894–'95 there was a profit of $6,670.56; and in 1895–'96 a loss of $12,288.45.

In five years, therefore, there was nominally a profit of about $60,000 in this department, but since neither interest, sinking fund, nor maintenance of the laborers is included among the expenses, the system can be looked upon only as a means of giving needed exercise to the prisoners and cheap grain sacks to the farmers. Financially it is a burden to the taxpayers. The old contract system had its drawbacks, but it at least afforded a profit, and gave convicts a chance of learning something about certain trades at which they could perhaps work when released; the jute mill not only offers no such opportunity, but is in other ways peculiarly unfit for modern prison requirements, since all operations in such mills can be stopped or delayed by the misbehavior of a few operatives. Far better are industries wherein small groups or individuals are engaged in various separate minor operations. Besides this, the sacks made by prison labor will probably have only local uses hereafter, because of a recent act of Parliament which is held to prevent wheat shipments in such sacks.

The Folsom Prison owns a magnificent water power and enormous quarries of granite. Between 1888 and 1894 convict labor amounting to 683,555 days were expended upon a dam, canal, and powerhouse, and over 2,000 horse power can already be used. About 250 horse power is now utilized by the prison for electric lights, ice manufacture, and other purposes. The quarries are being worked to some extent, and crushed rock for roads is sold at cost or nearly so. There is a farm that supplies many articles at less cost than if purchased in the market. At Folsom, as at San Quentin, the authorities do all in their power to economize, and to utilize convict labor, but the policy of the State prevents definite progress.

Meanwhile the reports of the prison directors and wardens and the messages of Governors have urged in the strongest terms a change. The biennial report of 1892–'93 and 1893–'94 says respecting the great Folsom water power: "If we can use this power solely with regard to profitable results to the State, we can return each year a surplus into the State treasury. We do not think that the State should refrain from working its convicts or utilizing its advantages because it may have some effect upon other businesses. All over the United States prisoners are engaged in manufacturing, and our investigations lead us to believe that the effect of prison competition, so called, is greatly overestimated."

The biennial report of 1894–'95 and 1895–'96 returns to the subject, states that the jute mills can not be a success under the restric-



Folsom State Prison.

tions of the present law, and urges that they should be run on a business basis, for a profit. It continues, "One source of profit would be to make use of the granite owned by the State" (at Folsom). It suggests a consolidation of the two prisons at Folsom, where, with prison labor and free power, and granite on the ground, a model prison could be constructed. Warden Aull, of Folsom Prison, in discussing the subject in 1896, said that for nine years the improvements there have employed the convicts, but now some new scheme must be devised. "The convicts must be kept at work. Every consideration of discipline, economy, reformation, and health demands this." But he believes that it will not pay the State to make shoes, blankets, clothing, brooms, tinware, etc. (as has been suggested at various times) for the eight thousand inmates of our State institutions. There are over two thousand convicts at Folsom and San Quentin. Only a small part of these, he says, could be utilized in making goods for State institutions, nor would there be any profit unless manufacturing was on a large scale for the outside markets as well. The experiment that New York is making will be watched with much interest here.

The California labor unions recently adopted resolutions favoring "the quarrying of stone by convict labor, and the placing it upon market undressed at a low figure, in order to give employment to stone-cutters, stone-masons, and others employed on buildings." The State rock-crushing plant, if kept running, will utilize the labor of about two hundred and fifty convicts. Any advance beyond this point means open war with all the labor unions.

Evidently the time when the prisons of California are to be entirely self-supporting is still remote, and the public as well as the union need much more education upon the subject. Some reduction of expenses, together with any utilization of convict labor that indirectly benefits a few classes, is all that can be hoped for at present, but ultimately the reformation of the criminal by making him capable of self-support as well as anxious to live in peace with society, will be recognized as the aim of wise penal legislation.

There is no doubt but that many profitable industries can be found, as yet unnaturalized in California, and therefore coming only incidentally into competition with existing industries, but well adapted to prison labor. One of these industries is the growth and preparation of osier willows of many species, and their manufacture into many useful forms, especially into baskets for fruit pickers and for wine makers. Another possible industry is the growth and preparation of various semitropic species of grasses and fiber plants, from which hat materials, mattings, the baskets used in olive-oil manufacture and a multitude of other articles can be made. The sale of crushed rock at Folsom should, of course, be at a price which at least pays for the sustenance of the convicts employed. The enormous water power of the prison should ultimately be fully utilized for manufacturing purposes.

Let us now turn to a consideration more in detail of the separate prisons, and to a brighter side—that which concerns the men who are doing the best they can with a bad system. San Quentin, the oldest of the two, has been for six years under the wardenship of an able and attractive man, William E. Hale, formerly Sheriff of Alameda County. Those who have read the wonderfully interesting reports of the National Prison Convention are familiar with his methods and views. The report for 1895 (Denver meeting) shows that Warden Hale, in the breadth and sanity of his views, easily takes rank among the best wardens of the country. He thoroughly understands California and the Californians, and while progressive has never attempted the impossible. In his various reports and addresses he especially urges more industrial schools, better care of children, and more kindergartens, such as those established in San Francisco by the late Sarah B. Cooper. And, indeed, who can read Kate Douglas Wiggin's story of Patsy without recognizing the value of kindergartens in the prevention of crime? The San Francisco police once traced the careers of nine thousand kindergarten pupils, and found that not one had ever become a law-breaker.

Last summer San Quentin was the scene of an "epidemic of noise" on the part of many of its inmates. Some of the newspaper accounts of the affair were painfully exaggerated, and the prison management in consequence was severely criticised. The fact is that the outbreak was quelled rapidly and effectually, without outside help, with only a few days' interruption of work on the jute mill, and without injury to any person. A hose was simply turned into the noisy cells until their inmates were subdued.

There have been very few escapes in the history of the prison, and none in recent years. Its situation, on the extreme eastern end of a rocky peninsula of Marin County, projecting into the bay of San Francisco, is extremely well chosen for safety and isolation. The State owns a large tract here, but it is very poor soil, and much of its surface clay has been stripped for brick-making, so that no income from it is possible unless more bricks can be made and sold. The prison accommodations are extremely cramped, and large quantities of brick should be used in needed extensions. Many small industries could be carried on here, if permitted, for water carriage to and from San Francisco is very cheap. Heavy manufactures requiring expensive steam power are not justified here.

The abandonment of the large State improvements at San Quentin seems contrary to the dictates of economy. Equally unwise is the suggestion that it be made a prison to which only the most dangerous classes of criminals should be sent. On the other hand, Folsom, with its quarries and water power, seems fitted for a receiving prison, where all convicts, without exception, should be placed on indeterminate sentences at hard labor, and from which, on good behavior, on the credit system, they might be removed by the prison directors to San Quentin, there to work at more varied but no less self-supporting trades. The ponderous jute-mill machinery should all be transferred to Folsom, where power is now running to waste. At San Quentin, first, the State should adopt more advanced reformatory methods.

Official statistics of the two prisons contain many interesting features. In mere numbers the increase during the past two decades has not kept pace with the increase in the State's population. San Quentin at present usually contains about fourteen hundred and Folsom about nine hundred, but an increase equal to the gain in population would give them three thousand instead of twenty-three hundred. Even during the so-called hard times of recent years there has been no marked additions to the criminal classes in California, and the two great strikes—that of the ironworkers and that of the railroad brakemen and firemen—led to surprisingly few violations of the laws.

Close observers say that there has been a marked increase during the past decade in the number of tramps, and that petty criminals have increased everywhere. But there are no statistics of the county and township jails. It seems certain that many villages and small towns, even where incorporated, have increasing trouble with gangs of hoodlums who are rapidly fitting themselves for State prisons. The reform schools have been largely recruited from this semi-criminal element, but stronger laws, swifter punishment, more firmness in dealing with young offenders, and, in brief, a higher grade of public sentiment on the part of citizens of small towns is evidently necessary. According to recent discussions in the New York Evening Post, the same sort of thing occurs in staid New England, and there, as here, it is one of the most serious problems of the times. From such a class of idle and vicious boys the prisons will hereafter be recruited, rather than from newcomers.

The nativity tables of both prisons show that the number of California-born convicts ranges in recent years from eighteen per cent in 1890 to nearly twenty-five per cent in 1895–'96. In that year in San Quentin, out of 819 American-born convicts, 314 were born in California, 68 in New York, 44 in Pennsylvania, 41 in Illinois, 36 in Ohio, and 35 each in Massachusetts and Missouri. Oregon sends 12, Arizona 10; Washington and Nevada are represented by only one apiece. The Southern States, excepting Kentucky and Virginia, send very few. Something the same proportion throughout holds at Folsom, and fairly indicates the States from which the population of California is chiefly drawn. The total of American nativity at San Quentin is sixty-four per cent; at Folsom, as last reported, it was about sixty-five per cent. Of the foreign born (thirty-six per cent at San Quentin), 99 out of 481 were Irish, 82 were Chinese, 56 were German, 49 were Mexican, and 44 were English. No one doubts that the laws are strictly enforced against the Chinese and the Mexicans (meaning Spanish-Californians); the other classes have votes and influence, and often have better chances for avoiding punishment for misdeeds. Japan contributes only one convict to San Quentin and two to Folsom. The Chinese as a rule go to prison for assaults upon each other ("highbinding"), for gambling, or similar offenses, but seldom for crimes against Americans. The Mexicans generally come to grief from an old-time *penchant* for other people's horses, or from drunken "cutting scrapes."

A racial classification attempted at Folsom showed that out of 905 convicts 704 were Caucasian, 89 Indian and Mexican, 62 Mongolian, and 50 negroid. I do not find this elsewhere, so it may stand alone as merely one year's observations.

Of much more importance are the statistics of illiteracy, kept for a term of years. Warden Hale reports in 1896 that out of 1,287 prisoners, 120 can neither read nor write, 220 can read but can not write, and 947 can both read and write. Of course, many who are rated in the third class read and write very poorly, and a careful classification in terms of the public-school system is essential to clearness. Warden Aull, at Folsom, reports that out of 905 convicts, 6 are college men, 81 are from private schools, 53 from both public and private schools, 582 have attended public schools only, and 147 are illiterate, while the remaining 36 call themselves "self-educated."

According to the evidence of the wardens, no full graduate of any American university has ever been an inmate of either prison. The so-called college men were men who had spent some time at a college of one kind or another. So-called professors appear among the convicts, but I have been unable to discover that any professor in an institution of standing has been at either San Quentin or Folsom since its establishment.

The preceding statistics of illiteracy are defective, but some additional light can be had from the tables upon occupations. Among 905 prisoners at Folsom, 96 occupations were represented. In round numbers, thirty-four per cent were mechanics, twenty-nine per cent were rated as laborers, twenty per cent were in business, and seven per cent were agriculturists. But a closer analysis of the statistics on this point shows that nearly fifty-seven per cent of the entire number came from the following occupations: acrobat, barber, bar-tender, butler, cook, gardener, hackman, hostler, laborer, laundryman, mill-hand, miner, nurse, sailor, vaquero, and "no occupation" (22).

The classification of crimes is very complete in all prison statistics, and usually follows the legal phraseology. Nearly all come under three great divisions—crimes against property, crimes of anger, and crimes which arise from a perverted sexuality. From year to year the proportion in these great divisions varies but little. In 1894 out of 1,287 convicts, 796 were sentenced for crimes against property, 358 of which were for burglary, 170 for grand larceny, and 39 for forgery; there were 343 commitments for assaults and murder, 188 of which were for murder in either the first or the second degree; lastly, there were 85 commitments for rape and other sex crimes.

This was a typical year, and will serve to illustrate for all and at both prisons.

The terms of imprisonment are long: out of 1,300 men in one annual report, 143 were for life, and 392 for ten years or more. Over 300 prisoners had served more than one term, and some were even serving their eighth term. Some at Folsom have reached their twelfth term. The ages of the prisoners have ranged from sixteen to eighty-six, but the danger period is evidently between eighteen and forty.

All of the prison officers agree respecting the bad physical condition of the convicts. Many of them are weak and ill when they enter the prison; many are the victims of unnamable personal vices. The physicians at San Quentin in 1895 reported 27 cases of scrofula, 30 of syphilis, 22 of epilepsy, 29 of opium habit, 62 of rheumatism, 70 of typhus fever, and 124 of general debility. Medical statistics at Folsom show similar conditions, aggravated by the malarial climate of that locality. The death rate, formerly higher at Folsom than at San Quentin, is now considerably lower, owing to the much better accommodations for the prisoners, and the hard outdoor labor required. In 1896 it was but .79 of one per cent.

It is gratifying to observe that the cost of maintenance of the prisoners has been gradually reduced. Nearly thirty years ago legislative committees reported that the cost of running the State's prisons was four or five times as much in proportion to the inmates as that of any other State in the Union, and that the prisoners lived better than the average landowner. More economical methods were gradually adopted, and by 1891 the cost per diem of a convict was 40 cents. This has been still further reduced; at San Quentin to 30.45 cents, and at Folsom to 32.50 cents.

There will always be outside criticisms of the food supplied as "too good for convicts," but it is merely that of ordinary field laborers, with much less variety. Under California conditions it could not well be made cheaper. If the food statistics of the prisons were so compiled as to separate the butter, olives, raisins, canned fruit, etc., properly used on the tables of officers and wardens, from the articles purchased for the prisoners, much misapprehension would be prevented.

As long as the State pays the entire expense bill, however, there will be a natural restiveness on the part of the taxpayers; the prison management, no matter how careful it is, must suffer for the sins of the system. The present directors and wardens are intelligent and honest men, who could put the prisons on a self-supporting basis if they had the authority and the necessary means for the plant required. A comparatively small amount of manufactures would pay the daily maintenance of the prisoners, and thus render the management much less subject to public criticism.

This article is already as long as seems desirable, and I must close without describing the California reform schools, which are comparatively new, but have attracted much attention. At some future time I may have an opportunity to take up that subject.

THE SCIENTIFIC EXPERT AND THE BERING SEA CONTROVERSY.

By GEORGE A. CLARK.

IN the November number of the Popular Science Monthly for 1897, Dr. Thomas C. Mendenhall reviews at some length the workings of the Bering Sea Commission of 1892. Dr. Mendenhall was himself a member of this commission, and his account of its inside history is interesting and instructive as throwing light upon the after-work of the Paris Tribunal of Arbitration for which it was to prepare the natural-history data.

Dr. Mendenhall naturally finds little to commend in the work of his colleagues, the British experts, but he does not stop there, and proceeds to generalize in an uncomplimentary way regarding scientific experts as a class. For example, he lays down the following just and admirable rule for scientific investigation: "It should be commenced with no preconceived notions of how it is to come out, and judgment should wait upon facts," and then continues to say: "Justice to the man of science obliges the admission that, take him in his laboratory or library, with no end in view except that of getting at the truth, and he generally lives fairly up to this high standard; but transform him by the magic of a handsome retainer, or any other incentive, into a scientific expert, and he is a horse of another color."

It is not the purpose of this article to argue the cause of the man of science, or to say whether or not this arraignment is just. It is the intention merely to bring into contrast with the notable example of failure which Dr. Mendenhall cites, an equally notable example of success on the part of the scientific expert. If I mistake not, this simple comparison will be all the vindication the man of science needs.

To understand the full force of Dr. Mendenhall's article, it must be remembered that it appeared on the very eve of the meeting of a second Bering Sea Commission called to consider the selfsame issues which occupied the attention of the commission of 1892. The article therefore stands as a prediction of failure for the new commission.

Nor does Dr. Mendenhall leave his meaning obscure in this regard. He says, "It is difficult to see what good will come from further discussions, investigations, or declarations"; and his conclusion is, "It will be impossible to know absolutely which group of scientific experts (American or British) was right in regard to pelagic sealing," this last subject being the rock on which the commission of 1892 split.

It is not necessary here to go into the details of this first commission. These are given in Dr. Mendenhall's article. Two things only are essential to bring this meeting into contrast with the one of 1897. These are the instructions under which it was organized and its final report. Both are brief. The first is comprehended in the following statement, quoted from the Treaty of Arbitration of 1892: "Each Government shall appoint two commissioners to investigate conjointly with the commissioners of the other Government all facts having relation to seal life in Bering Sea, and the necessary measures for its protection and preservation."

The commissioners duly visited the fur-seal islands in Bering Sea, made their investigations, and were called together at Washington to deliberate upon the results obtained, and to prepare a joint report for the guidance of the Tribunal of Arbitration then about to convene at Paris. With Dr. Mendenhall was associated, on behalf of the United States, Dr. C. Hart Merriam. Great Britain was represented by Sir George Baden-Powell and Dr. George M. Dawson. The commission began its labors on the 8th of February, and completed them on the 4th of March following. Its final report, shorn of verbiage, consists of the following colorless statement: "We find that since the Alaska purchase a marked diminution in the numbers of the seals on and habitually resorting to the Pribilof Islands has taken place; that it is cumulative in effect, and that it is the result of excessive killing by man." One half of the work set for the commission—namely, measures for protection—was left wholly untouched.

In view of this meager and unsatisfactory result, it is perhaps not to be wondered at that Dr. Mendenhall should grow skeptical of the value of expert scientific evidence. But had he sought a cause of the failure of 1892 he might easily have found one more rational than the alleged "handsome retainer," or other "incentive."

It is manifestly true that the man of science can legitimately appear as an "expert" only when his evidence is desired on some line along which he has done work. An invertebrate morphologist is not an expert in electricity; nor a physicist in the habits of pinnipeds. One only of the four gentlemen, called upon in 1892 without their own consent to act as experts, had even a passing knowledge of the life history of marine mammals. Dr. Mendenhall was a physicist, Dr. Dawson a geologist, and Sir Baden-Powell something of a sportsman. Dr. Merriam alone, a mammalogist of the first rank, was a scientific expert in any proper sense.

Moreover, the investigations conducted by the two commissions were, from a scientific point of view, of the nature of a farce. Less than two weeks were spent upon the islands, and that at a date in the season least favorable of all for observations. This meant that the greater part of their information was got second-hand by the commissioners.

In marked contrast to the findings of the joint meeting is the individual report of the American commission, prepared largely by Dr. Merriam. This stands out as a notable contribution to the subject of which it treats. Though largely a compilation, so well was the work of sifting and weighing evidence done, that not a single statement of fact in it has proved fallacious, and the more exhaustive investigations of 1896 and 1897 corroborate its conclusions in every particular. This was the work of the true "scientific expert," and he can ask no better vindication. The joint commission contained "experts" of another sort, and its report was necessarily different.

The second Bering Sea Commission came into existence in much the same way as the first. An agreement was reached in 1896 between the two nations whereby the entire fur-seal question should become the subject of a new investigation. This agreement was the outgrowth of dissatisfaction on the part of the United States with the workings of the regulations of the Paris award.

The new investigation was begun at once and extended through the seasons of 1896 and 1897, and again the experts were called together at Washington to agree, if possible, on a joint statement of fact. The scope of the investigation and the object of the joint meeting are succinctly stated in the following words quoted in the preamble of the commission's report: "To arrive, if possible, at correct conclusions respecting the numbers, conditions, and habits of the seals frequenting the Pribilof Islands at the present time as compared with the several seasons previous and subsequent to the Paris award."

In the commission of 1897 the United States were represented by Dr. David S. Jordan and Hon. Charles S. Hamlin; Great Britain, by Prof. D'Arcy W. Thompson and Mr. James M. Macoun. It convened on the 10th of November and concluded its labors on the 17th, reaching a full and satisfactory agreement.

It will best serve our purpose to give the final report of the commission of 1897 in full. Two reasons make this appropriate: First, the substance of the sixteen concisely worded propositions of which it is made up can scarcely be stated in fewer words than the original. In fact, instead of condensing them, it will be necessary to amplify and explain many of the points made in order to be sure that they are clear to the lay reader. Second, the report has for some reason received practically no notice in the American press, and it is to be feared that the importance of the document has not been fully appreciated by the American public.

1. There is adequate evidence that since the year 1884, and down to the date of the inspection of the rookeries in 1897, the fur-seal herd of the Pribilof Islands, as measured on either the hauling grounds or breeding grounds, has declined in numbers at a rate varying from year to year.

This proposition is in effect a restatement of the first clause of the agreement of 1892, but it is much more definitely put. The decline is not made to date vaguely "since the Alaska purchase" (1867), but "since the year 1884." This latter date is significant for a number of things. Prior to it for a period of thirteen years there had been no difficulty in securing the normal quota of 100,000 skins annually. In other words, up to that time the herd had remained in a state of equilibrium, yielding a maximum product. Again, this date marks the advent of pelagic sealing in Bering Sea, and the beginning of that remarkable expansion of the industry which culminated ten years later in 1894. The decline of the herd is thus made synonymous with the rise of pelagic sealing.

The real significance of this proposition, however, lies in the fact that the decline is declared to have been continuous to the present time. In other words, it did not stop or even slacken with the season of 1894. In this season, it will be remembered, the regulations of the Paris award, avowedly for the "protection and preservation of the fur-seal herd," went into effect. Translated into direct statement, this proposition is an admission that the regulations have failed of their object.

2. In the absence for the earlier years of actual counts of the rookeries such as have been made in recent years, the best approximate measure of decline available is found in these facts:

a. About 100,000 male seals of recognized killable age were obtained from the hauling grounds each year from 1871 to 1889. The table of statistics given in Appendix I* shows, on the whole, a progressive increase in the number of hauling grounds driven and in the number of drives made, as well as a retardation of the date at which the quota was attained during a number of years prior to 1889.

b. In the year 1896, 28,964 killable seals were taken after continuing the driving till July 27th, and in 1897 19,189 after continuing the driving till August 11th. We have no reason to believe that during the period 1896 and 1897 a very much larger number of males of recognized killable age could have been taken on the hauling grounds.

The reduction between the years 1896 and 1897 in the number of killable seals taken, while an indication of decrease in the breeding herd, can not be

* See footnote on next page.

taken as an actual measure of such decrease. A number of other factors must be taken into consideration, and the real measure of decrease must be sought in more pertinent statistics, drawn from the breeding rookeries themselves.

We have already noted that in that portion of the period, 1871 to 1889, which falls prior to 1884, thirteen years in all, no difficulty was experienced in securing the full quota, and it may be added that this was completed not later than July 20th. A retardation of the date at which the quota can be filled is a direct indication of the degree of exhaustion of the hauling grounds. In marked contrast with these earlier years stand the conditions of 1896 and 1897, when greatly reduced quotas only were obtained, notwithstanding the unusual prolongation of the driving period.

The statement here made that the difference between the quotas of 1896 and 1897 is not an actual measure of decline in the breeding herd requires explanation. The quota of any year is dependent upon the birth rate of three years previous, killable seals being males of approximately three years of age. The difference noted, therefore, while not indicative of the actual decrease for the seasons 1896 and 1897, is a direct measure of such decrease for the seasons of 1893 and 1894, when the seals in question were born.

That the rate of decline as thus shown was greater in 1893–'94 than in 1896–'97 is explained by the fact that, whereas only 30,000 seals were taken at sea in 1893, 60,000 were taken in 1894; while in 1896 43,000 were taken as against only 25,000 in 1897. In other words, the pelagic catch of 1894 exceeded that of 1893 by one hundred per cent, while that of 1897 fell seventy-two per cent below that of 1896. It is not, therefore, strange that the quota of 1897 should show a reduction of thirty per cent as against one of twelve per cent in the breeding herd for the same year.

3. From these data it is plain that the former yield of the hauling grounds of the Pribilof Islands was from three to five times as great as in the years

* This table of statistics need not be quoted here in full. The following section, embracing the ten years prior to 1889 and including 1884, will suffice:

Year.	Date quota filled.	Hauling grounds driven.	Number of drives.	Killed on land.	Killed at sea.
1879	16	71	36	110,411	8,557
1880	17	78	38	105,718	8,418
1881	20	99	34	105,063	10,382
1882	20	86	36	99,812	15,551
1883	19	81	39	79,509	16,557
1884	21	101	42	105,434	16,971
1885	27	106	63	105,024	23,040
1886	26	117	74	104,521	28,494
1887	24	101	66	105,760	30,628
1888	27	102	73	103,304	26,189
1889	31	110	74	102,617	29,858

1896 and 1897, and the same diminution to one third or one fifth of the former product may be assumed when we include also the results of the hunting at sea.

This proposition needs little comment. It is a simple deduction from the conditions of the preceding paragraph. The minimum estimate of former conditions is the lowest possible figure that could be in any way defended. The larger figure is apparently more nearly correct. The quota of 1898, of which we now have the record also, was about 18,000. It is not so stated in this paragraph, but the inference is inevitable that what is thus given as the decline of the "yield of the hauling grounds" is equally the decline of the breeding herd. A breeding herd which yielded without difficulty annually 100,000 killable animals (superfluous males of three years of age) must be reduced to something like one fifth its former size when it is able only with extreme difficulty to yield a quota of 20,000 such animals.

4. The death rate among young fur seals, especially among the pups, is very great. While the loss among the pups prior to their departure from the islands has been found in the past two years to approach twenty per cent of the whole number born, and though the rate of subsequent mortality is unknown, we may gather from the number which return each year that from one half to two thirds have perished before the age of three years—that is to say, the killable age for the males and the breeding age for the females.

The maximum and minimum figures here represent a division of opinion. The larger figure of two thirds would even seem to be a conservative estimate. The birth rate of 1897, as we know from close estimate, was approximately 130,000; it must have been greater in 1894, approaching 200,000. From this larger birth rate only about 20,000 males survived (the quota of 1897). There was doubtless a like number of females, the sexes being equal at birth and subject to like causes of natural loss. This gives a total of 40,000 in all, out of a birth rate of 200,000, which survived to the age of three years. This is one fifth, and it is evident that the mortality exceeds rather than falls below the maximum of two thirds.

5. The chief natural causes of death among pups, so far as known at present, are as follows, the importance of each being variable and more or less uncertain:

a. Ravages of the parasitic worm *Uncinaria;* most destructive on sandy breeding areas and during the period from July 15th to August 20th.

b. Trampling by fighting bulls or by moving bulls and cows, a source of loss greatest among young pups.

c. Starvation of pups strayed or separated from their mothers when very young, or whose mothers have died from natural causes.

d. Ravages of the great killer (*Orca*), known to be fatal to many of the young, and perhaps also to older seals.

At a later period drowning in the storms of winter is believed, but not certainly known, to be a cause of death among the older pups.

The causes of death here enumerated are natural and inherent in the conditions under which the herd exists. That some of them were not known or fully understood until the investigations of 1896 and 1897 does not make them new or recent in their action. They have been constant factors, acting with greater intensity in the past when the herd was larger and more crowded upon its breeding grounds. Photographs taken in 1891 and 1892 show that the parasitic worm was then doing its deadly work, and more extensively in proportion as the herd was larger. For 1,495 pups dead from this cause counted by us on Tolstoi sand flat in 1896, 4,000 were counted on the same ground by the British commissioner of 1892. Moreover, the bones of innumerable pups on ground already abandoned in that year by the declining herd attest the existence of this cause of death prior to that time. We have no reason to suppose that it has not always preyed upon the herd. Death by trampling must at present be at a minimum on account of the scattered condition of the rookeries. The storms of winter and pelagic enemies must, of course, take toll in proportion to the number of animals.

But the significant fact shown by this proposition is that the gain of the herd must be small at best under such a natural death rate. We may suppose these natural losses to have been the checks which in a state of nature prevented the indefinite increase of the herd, When, therefore, to this total loss of from two thirds to four fifths of the entire birth rate before breeding age is attained, we add the tremendous artificial loss through the destruction of gravid and nursing females resulting from pelagic sealing, it is not to be wondered at that the equilibrium was broken and the herd sent on a rapid decline.

6. Counts of certain rookeries, with partial counts and estimates of others, show that the number of breeding females bearing pups on St. Paul and St. George Island was, in 1896 and 1897, between 160,000 and 130,000, more nearly approaching the higher figure in 1896 and the lower in 1897.

These figures are based upon counts of all the breeding families on both islands for each season. On certain rookeries the live and dead pups were counted. In this way an average size of family was obtained which was used to complete the census where pups could not be counted.

7. On certain rookeries where pups were counted in both seasons, 16,241 being found in 1896 and 14,318 in 1897, or, applying a count adopted by Professor Thompson, 14,743 in the latter year, there is evident a decrease of nine to twelve per cent within the twelvemonth in question. The count of pups is the most trustworthy measure of numerical variation in the

herd. The counts of harems, and especially of cows present, are much inferior in value. The latter counts, however, point in the same direction. The harems on all the rookeries were counted in both seasons. In 1896 there were 4,932; in 1897 there were 4,418, a decrease of 10.41 per cent. The cows actually present on certain rookeries at the height of the season were counted in both seasons. Where 10,198 were found in 1896, 7,307 were found in 1897, a decrease of 28.34 per cent.

The important element in these special counts, undertaken with a view to determining the relative condition of the breeding herd for the two seasons, is the count of pups. All other classes of rookery population fluctuate from day to day, but the pups remain constantly on shore and near to the place of birth for the first six weeks of their lives, and it is merely a matter of patience and skill in counting them. Such a count on any rookery is an absolute record of the number of breeding females which has visited it for the season in question.

The minimum figure of nine per cent adopted by Professor Thompson is based upon a recount of a single rookery made by himself under conditions less favorable for accuracy than in the case of the official counts, which give the larger figure of twelve per cent, and which were made jointly by representatives of both commissions.

8. It is not easy to apply the various counts in the form of a general average to all the rookeries of the islands. We recognize that a notable decrease has been suffered by the herd during the twelvemonth 1896 to 1897, without attempting, save by setting the above numbers on record, to ascribe to the decrease more precise figures.

This is a rather extreme statement of the uncertainty which may be assumed to attach to these figures. The problem is not an easy one at best and its factors are complex. This should always be borne in mind, but not to the extent of doubting the value of the figures. The areas counted were large enough to be fairly typical. The counts were carefully done, and are accurate enough for all practical purposes. The probable error for the 15,000 more or less pups counted would not exceed 500. But as the counting was done in exactly the same manner and by the same persons for the two seasons, such errors as may exist are common to both counts and the relative conditions are unaltered. The figure of twelve per cent, moreover, must be taken as in itself a minimum, since it is the result of a number of individual counts varying in accuracy; and all in a sense underestimates, inasmuch as more animals are always overlooked among the rocks than are counted twice.

But the exact percentage of decrease is immaterial. That it has been a "notable" decrease is sufficient, and this is unquestioned. It may be noted in passing that this unequivocal decrease occurs in two seasons during which there was perfect enforcement of the regulations of the Paris award.

9. The methods of driving and killing practiced on the islands, as they have come under our observation during the past two seasons, call for no criticism or objection. An adequate supply of bulls is present on the rookeries; the number of older bachelors rejected in the drives during the period in question is such as to safeguard in the immediate future a similarly adequate supply; the breeding bulls, females, and pups on the breeding grounds are not disturbed; there is no evidence or sign of impairment of virility of males; the operations of driving and killing are conducted skillfully and without inhumanity.

It was agreed by the commission of 1892 that "excessive killing by man" was the cause of the decline of the herd. As to the "man" in question the two sets of commissioners differed diametrically. The Americans placed the responsibility with the pelagic sealer; the British, with the lessees through their methods of sealing on land.

To any one who is at all familiar with the conspicuous part which the theories of close killing, and especially overdriving, played in the British contention before the Paris Tribunal of Arbitration, this full and frank vindication comes as a refreshing surprise. That it should be agreed to by British scientific experts ought to revive even Dr. Mendenhall's faith. It is true that the statement is carefully limited to the seasons under observation, but neither the principle nor the methods of land killing have been altered within the past half century except in so far as they have been improved. It was an absurd and foolish theory which ascribed to the treatment of the non-breeding and superfluous male life of a herd of polygamous animals responsibility for the decline of its breeding stock, but it served a purpose useful to Canadian interests before the Paris tribunal. It is now forever eliminated from the fur-seal question.

10. The pelagic industry is conducted in an orderly manner, and in a spirit of acquiescence in the limitations imposed by law.

This statement is true, though wholly irrelevant to the question of the efficiency of the regulations themselves. Moreover, it stands as an implied impeachment of the active and efficient patrol fleet constantly maintained by the United States and Great Britain for the enforcement of the regulations governing the pelagic industry. For example, there were in 1896 five American and three British vessels engaged in active patrol of the waters of Bering Sea. One would think it a foregone conclusion that the pelagic industry should be law-abiding, whether of its own volition or not. In addition to all this, however, the regulations are as admirably suited to the needs of the pelagic sealer as if he had himself prepared them. There is, therefore, no reasonable incentive to violate them. Viewed in this light, this statement seems ludicrous, but it has a justification not evident at first sight.

The British experts demanded this statement as a balm for the wounded feelings of the pelagic sealer, and, such being the fact, the American commissioners assumed that it could do no harm to place it on record that he has conformed to the requirements of the law. But from the American point of view this paragraph has a wider and deeper meaning. We have seen in the opening paragraph that the decline in the herd has been continuous and uninterrupted during the period of the Paris regulations. It is admitted in paragraph 8 that the decrease for this same period has been a "notable" one. The rate is specified in paragraph 7 as from "nine to twelve per cent" during two years when the regulations were rigidly enforced. It only requires the climax of paragraph 10, asserting the perfect observance of the regulations, to complete their condemnation.

11. Pelagic sealing involves the killing of males and females alike, without discrimination and in proportion as the two sexes coexist in the sea. The reduction of the males effected on the islands causes an enhanced proportion of females to be found in the pelagic catch; hence this proportion, if it vary from no other cause, varies at least with the catch on the islands. In 1895 Mr. A. B. Alexander, on behalf of the Government of the United States, found 62.3 per cent of females in the catch of the Dora Sieward in Bering Sea; and in 1896 Mr. Andrew Halkett, on behalf of the Canadian Government, found 84.2 per cent in the catch of the same schooner in the same sea. There are no doubt instances, especially in the season of migration and in the course of the migrating herds, of catches containing a different proportion of the two sexes.

There are two ways and two alone whereby killing by man affects the fur-seal herd—namely, killing on land and killing at sea. Land killing has been vindicated in paragraph 9. We have here the necessary condemnation of pelagic killing expressed in equally full and frank terms. Land killing takes only males and leaves an adequate supply of bulls for breeding purposes; pelagic killing takes males and females alike, the latter sex constituting 62 to 84 out of every 100 killed.

It is not a vital matter that the female sex should be found to predominate in the pelagic catch, except in so far as it proves the falsity of the returns made so persistently by the Canadian sealing captain that the sexes are taken in virtually equal proportion at sea. The essential thing is that females are killed at all. That three fourths of all the animals taken at sea (during one season 140,000 animals were so taken) are of this sex only emphasizes the destructive nature of this industry.

12. The large proportion of females in the pelagic catch includes not only adult females that are both nursing and pregnant, but also young seals that are not pregnant and others that have not yet brought forth

young, with such also as have recently lost their young through the various causes of natural mortality.

This statement is put in the mildest possible form out of consideration for the old-time British contentions that the breeding females did not leave the islands while their young were dependent upon them, and that those taken at sea were "barren." The investigations of 1896 and 1897 proved conclusively that every female of two years old and over taken at sea was pregnant, and that those over two years of age when taken in Bering Sea were in addition nursing, having dependent pups on the islands. The manner of statement seems to imply an equality in importance between "young" seals and "adults." As females are never killed on land, they are naturally of all ages when found at sea, and the young animals (yearlings and two-year-olds) are necessarily vastly in the minority.

13. The polygamous habit of the animal, coupled with an equal birth rate of the two sexes, permits a large number of males to be removed with impunity from the herd, while, as with other animals, any similar abstraction of females checks or lessens the herd's increase, or, when carried further, brings about an actual diminution of the herd. It is equally plain that a certain number of females may be killed without involving the actual diminution of the herd, if the number killed does not exceed the annual increment of the breeding herd, taking into consideration the annual losses by death through old age and through incidents of the sea.

This paragraph is really supplementary to 9 and 11. Neither the methods nor yet the principle of land killing are at fault. The animal being polygamous, a part of its male life can be removed with impunity. On the other hand, the killing of females leads to disastrous results.

The concluding sentence is a concession to diplomacy. It is true that a certain number of females may be killed without producing actual diminution. If pelagic sealing were stopped to-day the herd would naturally begin to increase. The measure of its increase would be the difference between the natural loss of adult breeders through old age and incidents of the sea, on the one hand, and the yearly accession of young breeders to bear their first pups, on the other. We can closely estimate the latter factor. It was equal, for example, to the quota of 20,000 in 1897, or sixteen and two thirds per cent of the birth rate. The quota was composed of males of approximately three years, and we may assume that a like number of three-year-old females entered the rookeries for the first time in the same season. We have then a gross gain to the breeding herd of sixteen and two thirds per cent.

We have no means of exact estimate for the loss of adult females because we do not know the period of life in the female. If, however, we estimate it at thirteen years, which seems to be a conservative figure, the animal would have ten years of breeding life. Then, from old age alone, ten per cent of the adult breeding females must die annually. This leaves a net gain of six and two thirds per cent with accidental factors unaccounted for. The killing of females which does not produce actual diminution must come well within this margin of six and two thirds per cent. It only remains to be stated that the pelagic catch of 1897, which was the smallest on record since 1884, exceeded fourteen per cent.

14. While, whether from a consideration of the birth rate or from an inspection of the visible effects, it is manifest that the take of females in recent years has been so far in excess of the natural increment as to lead to the reduction of the herd in the degree related above, yet the ratio of the pelagic catch of one year to that of the following has fallen off more rapidly than the ratio of the breeding herd of one year to the breeding herd of the next.

This paragraph corrects possible erroneous implications which might be drawn from the truism in the preceding paragraph. A certain number of females may be taken, etc., but so many in excess of the safety limit have been taken that the herd has been reduced "in the degree related above"—that is, for 1896–'97, nine to twelve per cent, and for 1884–'97, fifty to eighty per cent.

Dr. Mendenhall said: "It will be impossible to know absolutely which group of scientific experts was right (in 1892) in regard to pelagic sealing." The admission made in this paragraph, taken together with other admissions made in paragraphs 11 and 12, effectually disproves this prediction. It ought to be a source of gratification to Dr. Mendenhall and to his colleague, Dr. Merriam, to find it thus clearly proved that they were right and their British associates wrong.

The final clause is here again a diplomatic concession to take the sting out of the real admission. The rapid fall in the pelagic catch as compared with the more even decline of the breeding herd is a natural phenomenon. Pelagic sealing not only destroys the herd, but it is necessarily self-destructive because it preys upon its own capital. The more successful it is the sooner it must cease. With the decline of the herd it is itself declining, and the rapidity of its fall proves the nearness of the end. For the years since 1894 the pelagic catch has been 61,000, 56,000, 43,000, and 25,000 respectively. It is a significant fact that in four years, under regulations which permit the pelagic sealer to take all he can get, the product of his industry has fallen to less than one half.

15. In this greater reduction of the pelagic catch, compared with the gradual decrease of the herd, there is a tendency toward equilibrium, or

a stage at which the numbers of the breeding herd would neither increase nor decrease. In considering the probable size of the herd in the immediate future, there remains to be estimated the additional factor of decline resulting from reductions in the number of surviving pups, caused by the larger pelagic catch of 1894 and 1895.

The two statements in this paragraph are not related. The first is a part of the preceding paragraph and is self-evident. Should the pelagic catch continue to decrease, as it must, it will eventually come within the margin of six and two thirds per cent. It has yet to fall far before this end is reached. Then will come that much-mooted "equilibrium," when the herd will be too insignificant to be worthy of attack—the equilibrium of ruin. There is no comfort in this prospect, either for the pelagic sealer or for the owner of the herd, and it takes no note of the injury which has been accomplished in the past, much less of possible restoration in the future. The equilibrium here suggested is purely a figure of speech, another concession to diplomacy.

The final statement of this paragraph is more important. The starvation of pups as a result of the killing of mothers at sea has been a fact strenuously denied from the first by the British side of the fur-seal controversy. After the actual counting of 16,000 of these starved pups in 1896, this position could no longer be maintained. At the same time a specific admission of the fact of starvation and of the destruction of unborn pups was too difficult a matter for the British experts to face. These facts are left to be inferred from the "reductions in surviving pups" here noted and from the admission that "nursing and pregnant females" are taken in the pelagic catch. Stated directly, it is here admitted that on account of "the larger pelagic catch of 1894 and 1895," numbers of pups starved to death on the rookeries or died unborn with their mothers which in the course of Nature should have reached the killable and breeding age.

16. The diminution of the herd is yet far from a stage which involves or threatens the actual extermination of the species, so long as it is protected in its haunts on land. It is not possible during the continuation of the conservative methods at present in force upon the islands, with the further safeguard of the protected zone at sea, that any pelagic killing should accomplish this final end. There is evidence, however, that in its present condition the herd yields an inconsiderable return either to the lessees of the islands or to the owners of the pelagic fleet.

The statements of this concluding paragraph must be taken in close connection, and the "ifs" must be carefully noted if they are not to prove very misleading. The opening sentence refers to the biologic extinction of the herd as contrasted with its commercial ruin. The former is as yet far off, the latter is a matter of history, as is admitted in the concluding statement—"an inconsiderable return." This means simply that the herd has ceased to be a commercial factor, and henceforth under present conditions sealing, whether on land or at sea, must be conducted at a loss.

This has an important bearing upon the suggested impossibility of bringing about the extinction of the species. It all depends upon whether present conditions are maintained. The breeding islands and the sixty-mile protected zone must be guarded. It cost the United States $175,000 for patrol in 1896. England's expense was less, but still considerable. It is beyond reason that this expensive protection should be continued at a loss or without hope of ultimate restoration of the herd. Remove the protection for a single season and the herd would be practically exterminated. A scattered remnant would doubtless escape to maintain a melancholy equilibrium, or perhaps to recuperate and again attract the cupidity of some adventurous sealing captain, but the herd as such would be at an end.

Stated without reference to diplomatic necessities, this concluding paragraph admits two important things: first, that the herd of fur seals resorting to the Pribilof Islands is commercially ruined; second, that its extinction as a species only awaits the abandonment of certain arduous and costly measures of protection now maintained solely in the hope of more adequate protection and the ultimate restoration of the herd.

Such was the work of the Conference of Fur-Seal Experts of 1897. The handwriting of diplomacy is mingled with that of science in its findings, but the resulting obscurity affects only minor matters. The important issues of the vexatious Bering Sea controversy are squarely met and finally settled. It is needless to say that there no longer exists a fur-seal question. It is merely a question of how to get rid of the destructive agency of pelagic sealing. This is a matter for diplomacy to adjust. Any odium which may have attached to the "man of science" as a result of the failure of the meeting of 1892 is effectually wiped out, and if the lesson is read aright by the nations, henceforth the scientific expert must be counted an essential factor in the settlement of governmental disputes.

In a paper on the industrial applications of electro-chemistry, Mr. Thomas Ewan points out as among those that may yet be developed, that it is possible, by compressing sulphur dioxide and air into separate carbon tubes dipping in sulphuric acid, to cause the two gases to combine to form sulphuric acid, and at the same time furnish an electric current. "The alluring prospect," he says, "of obtaining electric energy as a by-product in a chemical works should be a sufficient incentive to efforts to overcome the numerous difficulties in the way."

A SCHOOL FOR THE STUDY OF LIFE UNDER THE SEA.

(*Naples Aquarium.*)

BY ELEANOR HODGEN PATTERSON.

TO go deep down under the sea, in the warm waters of the south, where exist not only the varieties of fish with which we are familiar, but thousands of jewel-like forms of animal life never seen by us, has hitherto been impossible to any but the boldest fishermen and divers. But of late years in the small aquarium at Naples the sea has been brought up, so to speak, upon the earth for us to see these strange creatures as they exist in their homes under the water, as they eat their food, as they love and hate, and prey upon each other.

Small as the collection at first seems to be, there is no zoölogical station in the world to compare with it. Probably there never will be again. Because of its advantageous station on the shores of the Mediterranean, where it is claimed the waters which wash Italy and Sicily yield a greater variety of sea life than even tropical waters, and also its comparative accessibility to all countries, the scholars who come here from all over the world find that they are able to study here as they can nowhere else the strange habits of the tiny animals down at the bottom of the sea.

There is no superfluous room taken up in the Naples aquarium for the fish that may be studied in aquariums elsewhere. Only the rarest, the strangest, the most curious creatures are here to be seen.

But one room of the beautiful building devoted to the zoölogical station, which stands on that street of Naples running along the sea, is shown to the public. One walks into it from the level of the street, and the transition from the light outside to strange semi-darkness is as if one were to suddenly find himself walking upon the bottom of the sea.

The light comes only from above, shining through water of many hundreds of cubic feet, on to what seems at first a garden of moving flowers behind tanks of clear glass, which seem, so complete is the illusion, not like glass at all, but water. The visitor walks along dark alleys lined on both sides with these brilliant tanks, and the beautiful sea animals are so close that it seems easy to touch them. It is like being in a narrow, dark theater with the stage all around and about, strangely illuminated, not by footlights, but by a radiance from above.

There are about thirty tanks in all, and at the very first of these glass-walled vats we stopped entranced. Behind it were piles of rocks shining in the water, and from every crevice grew what seemed brilliant flowers, but of colors so soft and waxlike that they were almost more lovely than our flowers of earth.

"Surely these deep red ones that cover the rocks to the left are a species of aster, and these are cacti, and these, yes, these reddish-brown one are chrysanthemums and nothing else."

But even as we spoke we saw the petals of first one, then another, flower wave back and forth, and in and out, with curious curling movements, as none of our flowers do, even in the most various winds, and then from above a long pole was suddenly thrust down into the water, at the end of which was stuck a piece of raw red meat about as large as a walnut.

It was the keeper come to feed his strange charges. Again and again were the bits of meat thrust down into the hearts of the sea flowers, and then we discovered with a kind of shock that these asters and cacti and chrysanthemums were not flowers at all, but flesh-eating animals, and that each waving petal was a mouth, by which the creature sucked in the blood of the meat.

When all the juice had been extracted from the meat, the many mouths attached to each seeming flower, that had been tightly curled upon the raw flesh, now unfolded again into their petal-like positions in a circle, one over the other, and the meat, now but a tiny ball of dry pulp, slowly sank to the bottom of the tank. What the calyx was like, or whether it had any body at all, we could not see, so entirely hidden was it behind these many waving, armlike mouths.

In the next tank several sea horses were swimming merrily in and out of rocks that were covered by a growth of miniature trees. They were smaller than the tiniest hobbyhorse that has ever been seen, as small almost as the toy horses in a "Noah's ark." The resemblance of these small fish, not larger than smelts or minnows, that have come to be known as "sea horses," to real horses is in the head only. The rest of the body tapers off into the ordinary fishlike form. I wondered, as I looked at these small horses of the sea, if it was from them that the old myth of the existence of mermaids arose. "Half fish, half women" were the mermaids, but "half fish, half horses" are these fish.

They were lively little creatures, and swam in and out of the tiny forest as if they were playing a game of "tag." What a beautiful little forest it was to play in! The trees had brown trunks about the size of one's finger, and from the top a graceful, palmlike foliage branched out, but the foliage was not in greens, but deep, translucent reds, or coral pinks, or warm browns.

While I was admiring one of the little coral pink trees, one of the sea horses swam straight into its foliage, when, to my amazement, and evidently to the amazement of the sea horse also, the foliage instantly disappeared down into the tree trunk, leaving only the brown stem standing.

Aghast with surprise at the sudden revelation that this charming foliage, like the petals of the flowers in the last tank, was also a cluster of living suckers, I asked what name they were called by, and heard with disgust the answer "worms." These beautiful, curious creatures only the things we know by the loathsome word "worms!"

These sea worms, or annelids, as the scientific scholars call them, build up for themselves the brown tubes that resemble the rough stems of pines or palms, and from the top they send out their wormlike bodies in clusters, where they wave back and forth in the water, to sweep in any food that may be near, always holding themselves in readiness to withdraw into their holes at danger.

Whether the brilliant foliage of each tree was but the many tentacles of a single animal emerging from the tube, or whether it was a whole family of worms come up to the top of their home to gaze from the chimney, so to speak, we could not discover. But, strange to say, the grotesque little sea horse seemed to be trying to decide that question for himself, for, after swimming away a moment in fright at this sudden disappearance, he returned and appeared to be peeping down into the tube.

The next tank revealed even greater surprise than we had yet seen. Here in the water long white gauze ribbons were waving, as if hung from above, and so transparent that we could see quite through them, almost as if they were composed of the white of an egg. It was only by looking closely that up near the top we could see a tiny black dot, like a pinhead, in each fleecy scarf. This was the head of the animal, or its eye, or mouth, or whatever such a delicate dot might be called.

These are of the jellyfish family, and have only lately been added to the aquarium. Owing to the difficulty of procuring such pulplike masses, they are extremely rare specimens, and can be seen nowhere else. Surely nothing more frail, more delicately lovely exists on land or sea, in plant or animal life, than these gauzy living sashes of the sea.

But not all the denizens of the tanks are beautiful to look upon. There is a tank near the door of entrance filled with objects so hideous that one starts away from them with horror. These are the octopi, or devilfish. Imagine the ugliest, biggest black spider that you ever saw, and enlarge it to the size of the largest turtle you ever saw, and on the end of each of the spider's legs fasten a wicked-looking mouth, and you can form some idea of how frightful an octopus can be.

Several of these monsters were writhing near the glass wall, stretching out their long, boneless arms, and sometimes fastening their suckers upon the glass in the search for food, thus unconsciously showing off the ugliness of their mouths. It was now time for the keeper to come to them in his round of feeding. He put into the tank from above a number of crabs, when suddenly the whole tank seemed filled with octopi. They had been sleeping among the dark rocks, of which they were so much the color that we had not before observed them. The poor little crabs had probably been stunned, or perhaps killed, by the keeper, for they made no resistance when the octopi fastened upon them their long suckers in a death-grasp. The octopi fought with each other over the possession of the crabs, and for some moments there was a terrible waving to and fro of black suckers fully two yards in length.

Beside this tank was another of clear water in which were some peaceful cuttlefish. The keeper, for a few coins, stirred these out of their quiet by moving his long stick after them. They swam about in fright for a moment or two, and then we saw them no more, for the clear water had suddenly become a thick black fluid. The cuttlefish had discharged their bags of ink to escape the pursuing enemy.

The upper floors of the zoölogical station are seldom shown to visitors, but these are almost more interesting than the tank room below. Here the great scholars who make a life study of these strange inhabitants of the deep have their tables; here the dredgings of the sea are brought by fishermen and divers for them to assort; here sea animals are developed by them from the egg, and even from invisible germs.

Each investigator into the strange lower world is furnished with his own aquaria, suited to the special branch he may be studying, for nearly all are interested in a special branch of zoölogy. One man has come a long distance to pursue the study of sponges, and he is furnished with a perfect garden of them, for they are brought up from this part of the Mediterranean in infinite variety.

Another student is studying the habits of mollusks, and basins and jars of these and their eggs are near him. There are divers' costumes hanging on the walls in which the *savants* may themselves descend to the bottom of the sea and study the inhabitants in their native houses.

There are laboratories and libraries here, adapted to the most exhaustive study, and a fleet of small boats is also kept exclusively for the use of the zoölogical station.

Fishermen constantly bring in baskets filled with what seems to be only wet rubbish, heaps of stones, and worthless bits of pulp.

This is examined and assorted by trained eyes, and placed in tanks of water where siphons are constantly pouring fresh sea water, after which the rubbish is quietly left until accustomed to its new quarters. Then cautiously this rubbish begins to move, the stones stir, and the pulp opens into the beautiful colors, the plants, the gauzy scarfs, and the numerous other strange things afterward shown to the public in the aquarium below.

Along the walls of these upper rooms are jars wherein are preserved many curious denizens of the sea that have been killed by powerful chemicals, which have surprised the delicate animals before their sensitive tentacles have had time to close, thus preserving to science many rare creatures impossible to keep long in captivity.

The great cost of this establishment is maintained in several ways—by the issuing of publications and scientific papers in several languages, by the rents from the desks or tables used by the investigators, and by the unusually large price of admission demanded from the public at the aquarium entrance. In addition to this are the fees from the students who come from afar to study here. A payment of four hundred dollars each gives students the right to study in the Naples zoölogical station for ten months of the year.

SCIENCE IN EDUCATION.*

By Sir ARCHIBALD GEIKIE, D. C. L., F. R. S.

WHEN the history of education during the nineteenth century comes to be written, one of its most striking features will be presented by the rise and growth of science in the general educational arrangements of every civilized country. At the beginning of the century our schools and colleges were still following, with comparatively little change, the methods and subjects of tuition that had been in use from the time of the middle ages. But the extraordinary development of the physical and natural sciences, which has done so much to alter the ordinary conditions of life, has powerfully affected also our system of public instruction. The mediæval circle of studies has been widely recognized not to supply all the mental training needed in the ampler range of modern requirement. Science has, step by step, gained a footing in the strongholds of the older learning. Not without vehement struggle, however, has she been able to intrench herself there. Even now, although her ultimate victory is assured, the warfare is by no means at an end. The

* An address to the students of Mason University College, Birmingham, at the opening of the session, October 4, 1898.

jealousy of the older *régime* and the strenuous, if sometimes blatant, belligerency of the reformers have not yet been pacified; and, from time to time, within our public schools and universities, there may still be heard the growls of opposition and the shouts of conflict. But these sounds are growing fainter. Even the most conservative don hardly ventures nowadays openly to denounce Science and all her works. Grudgingly, it may be, but yet perforce, he has to admit the teaching of modern science to a place among the subjects which the university embraces, and in which it grants degrees. In our public schools a "modern side" has been introduced, and even on the classical side an increasing share of the curriculum is devoted to oral and practical teaching in science. New colleges have been founded in the more important centers of population, for the purpose, more particularly, of enabling the community to obtain a thorough education in modern science.

The mainspring of this remarkable educational revolution has, doubtless, been the earnest conviction that the older learning was no longer adequate in the changed and changing conditions of our time; that vast new fields of knowledge, opened up by the increased study of Nature, ought to be included in any scheme of instruction intended to fit men for the struggle of modern life, and that in this newer knowledge much might be found to minister to the highest ends of education. Nevertheless, it must be admitted that utilitarian considerations have not been wholly absent from the minds of the reformers. Science has many and far-reaching practical applications. It has called into existence many new trades and professions, and has greatly modified many of those of older date. In a thousand varied ways it has come into the ordinary affairs of everyday life. Its cultivation has brought innumerable material benefits; its neglect would obviously entail many serious industrial disadvantages, and could not fail to leave us behind in the commercial progress of the nations of the globe.

So much have these considerations pressed upon the attention of the public in recent years that, besides all the other educational machinery to which I have referred, technical schools have been established in many towns for the purpose of teaching the theory as well as the practice of various arts and industries, and making artisans understand the nature of the processes with which their trades are concerned.

That this educational transformation, which has been advancing during the century, has resulted in great benefit to the community at large can hardly be denied. Besides the obvious material gains, there has been a widening of the whole range and method of our teaching; the old subjects are better, because more scientifically taught, and the new subjects enlist the attention and sympathy of large classes of pupils whom the earlier studies only languidly interested. Nevertheless, it is incumbent on those who have advocated and carried out this change to ask themselves whether it has brought with it no drawbacks. They may be sure that no such extensive reform could possibly be accomplished without defects appearing somewhere. And it is well to look these defects in the face and, as far as may be possible, remove them. In considering how I might best discharge the duty with which I have been honored of addressing the students of Mason College this evening, I have thought that it might not be inappropriate if, as a representative of science, I were to venture to point out some of the drawbacks as well as the advantages of the position which science has attained in our educational system.

At the outset no impartial onlooker can fail to notice that the natural reaction against the dominance of the older learning has tended to induce an undervaluing of the benefits which that learning afforded and can still bestow. In this college, indeed, and in other institutions more specially designed for instruction in science, provision has also been made for the teaching of Latin, Greek, and the more important modern languages and literatures. But in such institutions these subjects usually hold only a subordinate place. It can hardly be denied that generally throughout the country, even although the literary side of education still maintains its pre-eminence in our public schools and universities, it is losing ground, and that every year it occupies less of the attention of students of science. The range of studies which the science examinations demand is always widening, while the academic period within which these studies must be crowded undergoes no extension. Those students, therefore, who, whether from necessity or choice, have taken their college education in science, naturally experience no little difficulty in finding time for the absolutely essential subjects required for their degrees. Well may they declare that it is hopeless for them to attempt to engage in anything more, and especially in anything that will not tell directly on their places in the final class lists. With the best will in the world, and with even, sometimes, a bent for literary pursuits, they may believe themselves compelled to devote their whole time and energies to the multifarious exactions of their science curriculum.

Such a result of our latest reformation in education may be unavoidable, but it is surely matter for regret. A training in science and scientific methods, admirable as it is in so many ways, fails to supply those humanizing influences which the older learning can so well impart. For the moral stimulus that comes from an association with all that is noblest and best in the literatures of the past, for the culture and taste that spring from prolonged contact with the highest models of literary expression, for the widening of our sympathies and the vivifying of our imagination by the study of history, the teaching of science has no equivalents.

Men who have completed their formal education with little or no help from the older learning may be pardoned should they be apt to despise such help and to believe that they can very well dispense with it in the race of life. My first earnest advice to the science students of this college is, not to entertain this belief and to refuse to act on it. Be assured that, in your future career, whatever it may be, you will find in literature a source of solace and refreshment, of strength and encouragement, such as no department of science can give you. There will come times, even to the most enthusiastic among you, when scientific work, in spite of its absorbing interest, grows to be a weariness. At such times as these you will appreciate the value of the literary culture you may have received at school or college. Cherish the literary tastes you have acquired, and devote yourselves sedulously to the further cultivation of them during such intervals of leisure as you may be able to secure.

Over and above the pleasure which communion with the best books will bring with it, two reasons of a more utilitarian kind may be given to science students why they should seek this communion. Men who have been too exclusively trained in science, or are too much absorbed in its pursuit, are not always the most agreeable members of society. They are apt to be somewhat angular and professional, contributing little that is interesting to general conversation, save when they get a chance of introducing their own science and its doings. Perhaps the greatest bore I ever met was a man of science, whose mind and training were so wholly mathematical and physical that he seemed unable to look at the simplest subject save in its physical relations, about which he would discourse till he had long exhausted the patience of the auditor whom he detained. There is no more efficacious remedy for this tendency to what is popularly known as "shop" than the breadth and culture of mind that spring from wide reading in ancient and modern literature.

The other reason for the advice I offer you is one of which you will hardly, perhaps, appreciate the full force in the present stage of your career. One result of the comparative neglect of the literary side of education by many men of science is conspicuously seen in their literary style. It is true that in our time we have had some eminent scientific workers, who have also been masters of nervous and eloquent English. But it is not less true that the literature of science is burdened with a vast mass of slipshod, ungrammatical, and clumsy writing, wherein sometimes even the meaning of the authors is left in doubt. Let me impress upon you the obvious duty of not increasing this unwieldy burden. Study the best masters of style, and when once you have made up your minds what you want to say, try to express it in the simplest, clearest, and most graceful language you can find.

Remember that, while education is the drawing out and cultivation of all the powers of the mind, no system has yet been devised that will by itself develop with equal success every one of these powers. The system under which we have been trained may have done as much for us as it can do. Each of us is thereafter left to supplement its deficiencies by self-culture. And in the ordinary science instruction of the time one of the most obvious of these inevitable deficiencies is the undue limitation or neglect of the literary side of education.

But in the science instruction itself there are dangers regarding which we can not be too watchful. In this college and in all the other well-organized scientific institutions of the country the principles of science are taught orally and experimentally. Every branch of knowledge is expounded in its bearings on other branches. Its theory is held up as the first great aim of instruction, and its practical applications are made subsequent and subordinate. Divisions of science are taught here which may have few practical applications, but which are necessary for a comprehensive survey of the whole circle of scientific truth. Now, you may possibly have heard, and in the midst of a busy industrial community you are not unlikely to hear, remarks made in criticism of this system or method of tuition. The importance of scientific training will be frankly acknowledged and even insisted upon, but you will sometimes hear this admission coupled with the proviso that the science must be of a practical kind; must, in short, be just such and no other as will fit young men to turn it to practical use in the manufactures or industries to which they may be summoned. The critics who make this limitation boast that they are practical men, and that in their opinion theory is useless or worse for the main purposes for which they would encourage and support a great scientific school.

Now I am quite sure that those science students who have passed even a single session in Mason College can see for themselves the utter fallacy of such statements and the injury that would be done to the practical usefulness of this institution and to the general progress of the industrial applications of science if such short-sighted views were ever carried into effect. There can be no thorough, adequate, and effective training in science unless it be based on a comprehensive study of facts and principles, altogether apart from any economic uses to which they may be put. Science must be pursued for her own sake, in the first instance, and without reference to any pecuniary benefits she may be able to confer. We never can tell when the most theoretical part of pure science may be capable of being turned to the most important practical uses. Who could have surmised, for instance, that in the early tentative experiments of Volta, Galvani, and others last century lay the germ of the modern world-grasping electric telegraph? Or when Wedgwood, at the beginning of this century, copied paintings by the agency of light upon nitrate of silver, who could have foretold that he was laying the foundations of the marvelous art of photography?

There can be no more pernicious doctrine than that which would measure the commercial value of science by its immediate practical usefulness, and would restrict its place in education to those only of its subdivisions which may be of service to the industries of the present time. Such a curtailed method of instruction is not education in the true sense of the term. It is only a kind of cramming for a specific purpose, and the knowledge which it imparts, being one-sided and imperfect, is of little value beyond its own limited range. I by no means wish to undervalue the importance of technical instruction. By all means let our artisans know as much as can be taught them regarding the nature and laws of the scientific processes in which they are engaged. But it is not by mere technical instruction that we shall maintain and extend the industrial and commercial greatness of the country. If we are not only to hold our own, but to widen the boundaries of applied science, to perfect our manufactures, and to bring new departments of Nature into the service of man, it is by broad, thorough, untrammeled scientific research that our success must be achieved.

When, therefore, you are asked to explain of what practical use are some of the branches of science in which you have been trained, do not lose patience with your questioner, and answer him as you think such a Philistine deserves to be answered. Give him a few illustrations of the thousands of ways in which science, that might have been stigmatized by him as merely abstract and theoretical, has yet been made to minister to the practical needs of humanity. Above all, urge him to attend some of the classes of Mason College, where he will learn, in the most effectual manner, the intimate connection between theory and practice. If he chance to be wealthy, the experiment may possibly open his eyes to the more urgent needs of the institution, and induce him to contribute liberally toward their satisfaction.

Among the advantages and privileges of your life at college there is one, the full significance and value of which you will better appreciate in later years. You have here an opportunity of acquiring a wide general view of the whole range of scientific thought and method. If you proceed to a science degree you are required to lay a broad foundation of acquaintance with the physical and biological sciences. You are thus brought into contact with the subjects of each great department of natural knowledge, and you learn enough regarding them to enable you to understand their scope and to sympathize with the workers who are engaged upon them. But when your academical career is ended, no such chance of wide general training is ever likely to be yours again. You will be dragged into the whirl of life, where you will probably find little time or opportunity to travel much beyond the sphere of employment to which you may have been called. Make the most, therefore, of the advantages which in this respect you meet with here. Try to insure that your acquaintance with each branch of science embraced in your circle of studies shall be as full and accurate as lies in your power to make it. Even in departments outside the bounds of your own tastes and ultimate requirements, do not neglect the means provided for your gaining some knowledge of them. I urge this duty, not because its diligent discharge will obviously tell in your examinations, but because it will give you that scientific culture which, while enabling you to appreciate and enjoy the successive advances of other sciences than that which you may select for special cultivation, will at the same time increase your general usefulness and aid you in your own researches.

The days of Admirable Crichtons are long since past. So rapid and general is the onward march of science that not only can no man keep pace with it in every direction, but it has become almost hopelessly impossible to remain abreast of the progress in each of the several subdivisions of even a single science. We are entering more and more upon the age of specialists. It grows increasingly difficult for the specialists, even in kindred sciences, to remain in touch with each other. When you find yourselves fairly launched into the vortex of life you will look back with infinite satisfaction to the time when you were enabled to lay a broad and solid platform of general acquirement within the walls of this college.

Perhaps the most remarkable defect in the older or literary methods of education was the neglect of the faculty of observation. For the training of the other mental faculties ample provision was made, but for this, one of the most important of the whole, no care was taken. If a boy was naturally observant, he was left to cultivate the use of his eyes as he best might; if he was not observant, nothing was done to improve him in this respect, unless it were, here and there, by the influence of such an intelligent teacher as is described in Mrs. Barbauld's famous story of Eyes and No Eyes. Even when science began to be introduced into our schools, it was still taught in the old or literary fashion. Lectures and lessons were given by masters who got up their information from books, but had no practical knowledge of the subjects they taught. Class-books were written by men equally destitute of a personal acquaintance with any department of science. The lessons were learned by rote, and not infrequently afforded opportunities rather for frolic than for instruction. Happily, this state of things, though not quite extinct, is rapidly passing away. Practical instruction is everywhere coming into use, while the old-fashioned cut-and-dry lesson-book is giving way to the laboratory, the field excursion, and the school museum.

It is mainly through the eyes that we gain our knowledge and appreciation of the world in which we live. But we are not all equally endowed with the gift of intelligent vision. On the contrary, in no respect, perhaps, do we differ more from each other than in our powers of observation. Obviously, a man who has a quick eye to note what passes around him must, in the ordinary affairs of life, stand at a considerable advantage over another man who moves unobservantly on his course. We can not create an observing faculty any more than we can create a memory, but we may do much to develop both. This is a feature in education of much more practical and national importance than might be supposed. I suspect that it lies closer than might be imagined to the success of our commercial relations abroad. Our prevalent system of instruction has for generations past done nothing to cultivate the habit of observation, and has thus undoubtedly left us at a disadvantage in comparison with nations that have adopted methods of tuition wherein the observing faculty is regularly trained. With our world-wide commerce we have gone on supplying to foreign countries the same manufactured goods for which our fathers found markets in all quarters of the globe. Our traders, however, now find themselves in competition with traders from other nations who have been trained to better use of their powers of observation, and who, taking careful note of the gradually changing tastes and requirements of the races which they visit, have been quick to report these changes and to take means for meeting them. Thus, in our own centers of trade, we find ourselves in danger of being displaced by rivals with sharper eyes and greater powers of adaptation.

It is the special function of science to cultivate this faculty of observation. Here in Mason College, from the very beginning of your scientific studies you have been taught to use your eyes, to watch the phenomena that appear and disappear around you, to note the sequence and relation of these phenomena, and thus, as it were, to enter beneath the surface into the very soul of things. You can not, however, have failed to remark among your fellow-students great inequalities in their powers of observation, and great differences in the development of these powers under the very same system of instruction. And you may have noticed that, speaking generally, those classmates who have shown the best observing faculty have taken foremost places among their fellows. It is not a question of mere brain power. A man may possess a colossal intellect, while his faculty of observation may be of the feeblest kind. One of the greatest mathematicians of this century who, full of honors, recently passed away from us, had so little cognizance of his surroundings that many ludicrous stories are told of his childlike mistakes as to place and time.

The continued development of the faculty of prompt and accurate observation is a task on which you can not bestow too much attention. Your education here must already have taught you its value. In your future career the use you make of this faculty may determine your success or your failure. But not only have your studies in this college trained your observing powers, they have at the same time greatly widened the range of your mental vision by the variety of objects which you have been compelled to look at and examine. The same methods which have been so full of benefit to you here can be continued by you in after life. And be assured that in maintaining them in active use you will take effective means for securing success in the careers you may choose to follow.

But above and beyond the prospect of any material success there is a higher motive which will doubtless impel you. The education of your observing faculty has been carried on during your introduction to new realms of knowledge. The whole domain of Nature has been spread out before you. You have been taught to observe thousands of objects and processes of which, common though they may be, you had previously taken no note. Henceforth, wherever you may go, you can not wander with ignorant or unobservant eyes. Land and sea and sky, bird and beast and flower now awaken in you a new interest, for you have learned lessons from them that have profoundly impressed you, and you have discovered meanings in them of which you had never dreamed. You have been permitted to pass within the veil of Nature, and to perceive some of the inner mechanism of this world.

Thus, your training in science has not only taught you to use your eyes, but to use them intelligently, and in such a way as to see much more in the world around you than is visible to the uninstructed man. This widened perception might be illustrated from any department of natural science. Let me take, by way of example, the relation of the student of science toward the features and charms of landscape. It may be said that no training is needed to comprehend these beauties; that the man in the street, the holiday maker from town, is just as competent as the man of science to appreciate them, and may get quite as much pleasure out of them. We need not stop to discuss the relative amounts of enjoyment which different orders of spectators may derive from scenery; but obviously the student of science has one great advantage in this matter. Not only can he enjoy to the full all the outward charms which appeal to the ordinary eye, but he sees in the features of the landscape new charms and interests which the ordinary untrained eye can not see. Your accomplished professor of geology has taught you the significance of the outer lineaments of the land. While under his guidance you have traced with delight the varied features of the lovely landscapes of the Midlands, your eyes have been trained to mark their connection with each other, and their respective places in the ordered symmetry of the whole scene. You perceive why there is here a height and there a hollow; you note what has given the ridges and vales their dominant forms and directions; you detect the causes that have spread out a meadow in one place and raised up a hill in another.

Above and beyond all questions as to the connection and origin of its several parts, the landscape appeals vividly to your imagination. You know that it has not always worn the aspect which it presents today. You have observed in these ridges proofs that the sea once covered their site. You have seen the remains of long-extinct shells, fishes, and reptiles that have been disinterred from the mud and silt left behind by the vanished waters. You have found evidence that not once only, but again and again, after vast lapses of time and many successive revolutions, the land has sunk beneath the ocean and has once more emerged. You have been shown traces of underground commotion, and you can point to places where, over central England, volcanoes were once active. You have learned that the various elements of the landscape have thus been gradually put together during successive ages, and that the slow processes, whereby the characteristic forms of the ground have been carved out, are still in progress under your eye.

While, therefore, you are keenly alive to the present beauty of the scene, it speaks to you, at every turn, of the past. Each feature recalls some incident in the strange primeval history that has been transacted here. The succession of contrasts between what is now and what has been fills you with wonder and delight. You feel as if a new sense had been given to you, and that with its aid your appreciation of scenery has been enlarged and deepened to a marvelous degree.

And so, too, is it with your relation to all the other departments of Nature. The movements of the clouds, the fall of rain, the flow of brook and river, the changes of the seasons, the succession of calm and storm, do not pass before your eyes now as they once did. While they minister to the joy of life, they speak to you of that all-embracing system of process and law that governs the world. The wayside flower is no longer to your eyes merely a thing of beauty. You have found it to be that and far more—an exquisite organism in which the several parts are admirably designed to promote the growth of the plant and to perpetuate the life of the species. Every insect and bird is now to you an embodiment of the mystery of life. The forces of Nature, once so dark and so dreaded, are now seen by you to be intelligible, orderly, and capable of adaptation to the purposes of man. In the physical and chemical laboratories you have been brought into personal contact with these forces, and have learned to direct their operations, as you have watched the manifold effects of energy on the infinite varieties of matter.

When you have completed your course of study and leave this college, crowned, I hope, with academic distinction, there will be your future career in life to choose and follow. A small number among you may, perhaps, be so circumstanced as to be able to devote yourselves entirely to original scientific research, selecting such branches of inquiry as may have specially interested you here, and giving up your whole time and energy to investigation. A much larger number will, no doubt, enter professions where a scientific training can be turned to practical account, and you may become engineers, chemists, or medical men. But in the struggle for existence, which every year grows keener among us, these professions are more and more crowded, so that a large proportion of your ranks may not succeed in finding places there, and may in the end be pushed into walks in life where there may be little or no opportunity for making much practical use of the knowledge in science which you have gained here. To those who may ultimately be thus situated it will always be of advantage to have had the mental training given in this institution, and it will probably be your own fault if, even under unfavorable conditions, you do not find, from time to time, chances of turning your scientific acquirements to account. Your indebtedness to your professors demands that you shall make the effort, and, for the credit of the college, you are bound to do your best.

Among the mental habits which your education in science has helped to foster, there are a few which I would specially commend to your attention as worthy of your most sedulous care all through life.

In the first place, I would put accuracy. You have learned in the laboratory how absolutely essential this condition is for scientific investigation. We are all supposed to make the ascertainment of the truth our chief aim, but we do not all take the same trouble to attain it. Accuracy involves labor, and every man is not gifted with an infinite capacity for taking pains. Inexactness of observation is sure sooner or later to be detected, and to be visited on the head of the man who commits it. If his observations are incorrect, the conclusions he has drawn from them may be vitiated. Thus all the toil he has endured in a research may be rendered of no avail, and the reputation he might have gained is not only lost but replaced by discredit. It is quite true that absolute accuracy is often unattainable; you can only approach it. But the greater the exertion you make to reach it, the greater will be the success of your investigations. The effort after accuracy will be transferred from your scientific work to your everyday life and become a habit of mind, advantageous both to yourselves and to society at large.

In the next place, I would set thoroughness, which is closely akin to accuracy. Again, your training here has shown you how needful it is in scientific research to adopt thorough and exhaustive methods of procedure. The conditions to be taken into account are so numerous and complex, the possible combinations so manifold, before a satisfactory conclusion can be reached. A laborious collection of facts must be made. Each supposed fact must be sifted out and weighed. The evidence must be gone over again and yet again, each link in its chain being scrupulously tested. The deduction to which the evidence may seem to point must be closely and impartially scrutinized, every other conceivable explanation of the facts being frankly and fully considered. Obviously the man whose education has inured him to the cultivation of a mental habit of this kind is admirably equipped for success in any walk in life which he may be called upon to enter. The accuracy and thoroughness which you have learned to appreciate and practice at college must never be dropped in later years. Carry them with you as watchwords, and make them characteristic of all your undertakings.

In the third place, we may take breadth. At the outset of your scientific education you were doubtless profoundly impressed by the multiplicity of detail which met your eye in every department of natural knowledge. When you entered upon the study of one of these departments, you felt, perhaps, almost overpowered and bewildered by the vast mass of facts with which you had to make acquaintance. And yet as your training advanced, you gradually came to see that the infinite variety of phenomena could all be marshaled, according to definite laws, into groups and series. You were led to look beyond the details to the great principles that underlie them and bind them into a harmonious and organic whole. With the help of a guiding system of classification, you were able to see the connection between the separate facts, to arrange them according to their mutual relations, and thus to ascend to the great general laws under which the material world has been constructed. With all attainable thoroughness in the mastery of detail, you have been taught to combine a breadth of treatment which enables you to find and keep a leading clew even through the midst of what might seem a tangled web of confusion. There are some men who can not see the wood for the trees, and who consequently can never attain great success in scientific investigation. Let it be your aim to master fully the details of the tree, and yet to maintain such a breadth of vision as will enable you to embrace the whole forest within your ken. I need not enlarge on the practical value of this mental habit in everyday life, nor point out the excellent manner in which a scientific education tends to develop it.

In the fourth place, I would inculcate the habit of wide reading in scientific literature. Although the progress of science is now too rapid for any man to keep pace with the advance of all its departments, you should try to hold yourselves in touch with at least the main results arrived at in other branches than your own; while, in that branch itself, it should be your constant aim to watch every onward step that is taken by others, and not to fall behind the van. This task you will find to be no light one. Even were it confined to a survey of the march of science in your own country, it would be arduous enough to engage much of your time. But science belongs to no country, and continues its onward advance all over the globe. If you would keep yourselves informed regarding this progress in other countries, as you are bound to do if you would not willingly be left behind, you will need to follow the scientific literature of those countries. You must be able to read at least French and German. You will find in these languages a vast amount of scientific work relating to your own department, and to this accumulated pile of published material the journals of every month continue to add. In many ways it is a misfortune that the laterature of science increases so fast; but we must take the evil with the good. Practice will eventually enable you to form a shrewd judgment as to which authors or papers you may skip without serious danger of losing any valuable fact or useful suggestion.

In the fifth place, let me plead for the virtue of patience. In a scientific career we encounter two dangers, for the avoidance of which patience is our best support and guide. When life is young and enthusiasm is boundless; when from the details which we may have laboriously gathered together we seem to catch sight of some new fact or principle, some addition of more or less importance to the sum of human knowledge, there may come upon us the eager desire to make our discovery known. We may long to be allowed to add our own little stone to the growing temple of science. We may think of the pride with which we should see our names enrolled among those of the illustrious builders by whom this temple has been slowly reared since the infancy of mankind. So we commit our observations to writing, and send them for publication. Eventually we obtain the deep gratification of appearing in print among well-known authors in science. Far be it from me to condemn this natural desire for publicity. But, as your experience grows, you will probably come to agree with me that if the desire were more frequently and energetically curbed, scientific literature would gain much thereby. There is among us far too much hurry in publication. We are so afraid lest our observations or deductions should be forestalled—so anxious not to lose our claim to priority, that we rush before the world, often with a half-finished performance, which must be corrected, supplemented, or canceled by some later communication. It is this feverish haste which is largely answerable for the mass of jejune, ill-digested, and erroneous matter that cumbers the pages of modern scientific journals. Here it is that you specially need patience. Before you venture to publish anything, take the utmost pains to satisfy yourselves that it is true, that it is new, and that it is worth putting into print. And be assured that this reticence, while it is a kindness to the literature of science, will most certainly bring with it its own reward to yourselves. It will increase your confidence, and make your ultimate contributions more exact in their facts as well as more accurate and convincing in their argument.

The other danger to which I referred as demanding patience is of an opposite kind. As we advance in our career, and the facts of our investigations accumulate around us, there will come times of depression when we seem lost in a labyrinth of detail out of which no path appears to be discoverable. We have, perhaps, groped our way through this maze, following now one clew, now another, that seemed to promise some outlet to the light. But the darkness has only closed around us the deeper, and we feel inclined to abandon the research as one in which success is, for us at least, unattainable. When this blankness of despair shall come upon you, take courage under it, by remembering that a patient study of any department of Nature is never labor thrown away. Every accurate observation you have made, every new fact you have established, is a gain to science. You may not for a time see the meaning of these observations, nor the connection of these facts. But their meaning and connection are sure in the end to be made out. You have gone through the labor necessary for the ascertainment of truth, and if you patiently and watchfully bide your time, the discovery of the truth itself may reward your endurance and your toil.

It is by failures as well as by successes that the true ideal of the man of science is reached. The task allotted to him in life is one of the noblest that can be undertaken. It is his to penetrate into the secrets of Nature, to push back the circumference of darkness that surrounds us, to disclose ever more and more of the limitless beauty, harmonious order, and imperious law that extend throughout the universe. And while he thus enlarges our knowledge, he shows us also how Nature may be made to minister in an ever-augmenting multiplicity of ways to the service of humanity. It is to him and his conquests that the material progress of our race is mainly due. If he were content merely to look back over the realms which he has subdued, he might well indulge in jubilant feelings, for his peaceful victories have done more for the enlightenment and progress of mankind than were ever achieved by the triumphs of war. But his eye is turned rather to the future than to the past. In front of him rises the wall of darkness that shrouds from him the still unknown. What he has painfully accomplished seems to him but little in comparison with the infinite possibilities that lie beyond. And so he presses onward, not self-satisfied and exultant, but rather humbled and reverential, yet full of hope and courage for the work of further conquest that lies before him.—*Nature.*

SHALL WE TEACH OUR DAUGHTERS THE VALUE OF MONEY?

By ALEXANDRA L. B. IDE.

I AM induced to write a few lines on this subject by a remark recently made to me by a widow of large property. In speaking about the management of her money she said: "As to myself, I leave everything to my business man or agent. I would not know if my tax bills were correct. He gives me plenty of money to spend on my charities; why should I trouble myself about the details?" Evidently it had never occurred to her that she might be spending her principal; that some day she might wake up to the fact that her fortune had been dissipated. Another rich woman, to whom I made the remark that certain bonds were bought at par, inquired, "Is that the same thing as buying them on a margin?" Now here were representative women of New York society, both belonging to excellent families, and to all appearances well educated. It is amazing that such profound ignorance on ordinary business matters exists. In conversation with many other wealthy women I discovered that it was very much the exception to find a woman who possessed the slightest knowledge of money matters.

Now, why should these things be? The time has passed for a young girl to be brought up a "perfect fool." Let her not waste the beautiful morning of her life in profitless and frivolous occupations. The reason often given as excuse for the ignorance of many women is, so few comparatively have any money to keep, therefore it is useless to teach them.

True, it is unusual to find a young girl with an independent fortune; but she may marry rich, and what a help she would be to a sensible man if she were capable of aiding him in his business affairs! Again, she might be left a widow, and have the entire direction of her husband's property. No knowledge is ever lost. The more one knows, the more one realizes how little one does know. I maintain that a woman's intellect is perfectly capable of coping with and understanding business affairs. In some matters she is far shrewder than the average man, and in many cases her quick insight sees at a glance that which man requires time to penetrate. Only give her half a chance. I do not wish for a moment to be understood as advocating women becoming stockbrokers or lawyers; nothing could be more unnatural or unsuitable. It seems to me only in accordance with the wishes of a reasonable woman to participate with her brothers in such rudimentary knowledge as will enable her to oversee or take the entire charge of her own property. Take, for example, a well-to-do New York business man. He has acquired through his own industry and shrewdness a large fortune. He maps out the education for his children. His sons are sent to the best schools, and afterward to college. He determines that no expense shall be spared to fit them for their future career.

For his daughters expensive foreign governesses are engaged, who teach them the languages, music, and other accomplishments. Or the daughters are sent to some high-priced fashionable school, where they are put through a course of training to enable them to "shine in society." Having reached the age of eighteen, the daughter returns to the parental roof.

What does she know in exchange for the large sum of money her education has cost? Usually her penmanship is bad and illegible. Her knowledge of arithmetic very slight. These two essentials of education are not her forte.

But she is a good dancer, and perhaps at the assembly or some such function the father's heart has swelled with pride as he noticed how eagerly she was sought as a partner. She can sing French songs, probably those which are rather *risqué*. She can converse, perhaps, in two or three different modern languages. As a general rule her French can scarcely be understood by the foreign *attachés* at Newport. The girl is absolutely unequipped for *real* life, and the man of sense, who has passed the boyish age and is looking for a partner for life, knows *this*. Possibly this is one cause why there are comparatively few marriages in our best society. What man is less likely to seek as wife a woman who knows something about the care and value of money? It is strange that a father should be so blinded to the best interests of his daughter. Is it because he considers her intellect so far below that of his son that he makes no effort to instruct her in regard to the care of money? The only thing she knows about money is how to spend it—generally on herself, for clothes and jewels. Perhaps on the first of the month, when the bills for his daughter's extravagance pour in on him, he is vexed; but if his fortune is large, and it is no inconvenience for him to pay them, he generally does so without a murmur. "Let her have a good time while she is young," he soliloquizes.

But stop a moment and consider. What you sow you reap is as true in this material concern as in the world of agriculture. The fond parent by his indulgence and neglect is sowing the seeds of extravagance, perhaps those of want. Years hence she may reap the fruit of his ill-judged kindness in fostering habits of reckless expenditure.

In a few years the father dies; his property is divided; the daughter receives her share. If she is married to a good business man who has time to take charge of her fortune, possibly, during her husband's lifetime, the difficulty is bridged over. But the chances are she may not be married, or again the man she has selected as husband may be worthless as a business man. It is not to be expected that a brother (even if she is fortunate enough to possess one), however kind, will overburden himself with the manifold details of looking after the property of a sister. He has his own interests, which demand his attention. He thinks his duty accomplished when he has chosen a man to look after his sister's affairs whom he *believes* to be reliable. The person whom he has appointed as guardian over his sister's interests may have an honest and high character, but that is no guarantee that in a moment of weakness he may not yield to the temptation of abusing the trust. He knows the woman is absolutely ignorant of how her affairs are being conducted, and in all probability would not be the wiser if he appropriated some of her fortune to his own uses. Her very ignorance is his security. Who can not recall several such cases? If each day for half an hour the father had instructed his child in the essentials of business—how to calculate interest quickly, the manner of filling out a lease in renting property, explaining about mortgages, and giving her a lesson as to what were the best investments—she would know enough to steer clear of the many sharks and vultures which usually find her a ready prey. The woman who does not know the difference between a registered and coupon bond should be ashamed to acknowledge such ignorance. A parent's neglect in teaching his child about monetary affairs is culpable, almost amounting to a crime. There is nothing so costly as ignorance. This very fortune which you have taken infinite pains to accumulate will be perhaps dissipated, owing to your want of forethought in imparting the requisite knowledge to your child. This information she will in after years buy for herself at a heavy premium. If knowledge is power in other matters, it is more than ever true in monetary affairs. Power to keep your fortune is a power worth having, and more difficult to acquire than to make a fortune. Let a girl but try to earn five dollars, and she will see the task is not an easy one. Then, unless she be a fool, she will realize that what is so difficult to obtain should not be wasted.

I recall the case of a fashionable woman in New York society which came under my own observation. Her husband told me he had deposited in a bank a large sum of money for his wife to draw on, given her a bank and check book, explained and showed her how to draw checks. He very sensibly thought that it would be a far better plan for her to pay her bills herself, instead of coming to him every time she needed money. His relief from being her almoner was of short duration, for in less than a month she came to him, and, throwing the check and bank books on his library table, told him it was too much trouble—she could not make head or tail of it; she wished to return to the old system! He could pay her bills in future. This woman had been married twenty years. Too much trouble, is it? Yes, I believe this is the keynote why women are so ignorant. They are lazy, pure and simple. The details of business are too dry and uninteresting. It is so much easier to have some one else do the work for you. So much less exertion to read a novel, or ride the wheel with some attractive man. "How prosaic," you say, "to add up account books, balance check books, and calculate whether your tax bill is correct when your property is assessed at the rate of 2.01!"

I believe, if the truth were told, half the divorces in which the reason given is incompatibility of temper arise from the fact that women know nothing of the value of money. I am not speaking entirely of women who have their own property, but also of those who are dependent on a husband's income. The wife has a vague idea that there is an inexhaustible supply of cash somewhere! What man can not tell you how worried and harassed he felt when his wife came to him for money to spend on nonessentials, and which he could ill afford? If he attempted to remonstrate with her he probably received a rude or angry reply! The wife, perhaps, had been used to an indulgent father, who gratified her every whim. She overlooks the fact that a father and husband are two vastly different beings, and require different treatment. To some women a husband's value decreases when he can no longer supply them with finery. Their alleged love soon wanes, and a divorce is sought on any pretext.

It is easy to see that by a knowledge of business affairs a woman can dispense with the services of an agent or trust company, whose salary thus being saved is added to her income. In case a woman is fitted by a proper education for so doing, who could attend to her own interests better than herself, as she is the party interested? The phrase, "If you wish anything well done, do it yourself," is never better exemplified than in this case. Lastly, but not least, in saving our money it need not be from a miserly spirit; but the more we have, the more we can profitably give away. What pleasure equals that of relieving real distress, and of helping others? Did not our Saviour himself set the example of saving when, after performing the miracle where he fed the multitude with the loaves and fishes, he said: "Gather up the fragments that remain. Let nothing be lost."

SKETCH OF CLÉMENCE ROYER.

By M. JACQUES BOYER.

MADAME CLÉMENCE AUGUSTINE ROYER was born at Nantes, France, April 21, 1830, of an old Catholic family. When she reached a suitable age she was sent to school at the Sacré Cœur, where she received the most of her education. Very shortly after coming out of the convent she abandoned the religious doctrines they had tried to inculcate in her there, and, like so many young persons, was attracted to poetry. But her literary efforts as a whole received very little attention, and she would never have been successful if she had only teased the Muse. Happily, she applied herself, about 1850, to more serious studies, and went to England, where she spent several years and acquired a thorough knowledge of the language of Shakespeare. She removed thence to Switzerland, and there found her definite vocation. The natural sciences, philosophy, and political economy from that time engaged her attention.

The opening of Madame Royer's course of lectures to women on logic at Lausanne in the winter of 1859 and 1860 attracted much notice. The first lecture was published under the title of an Introduction to Philosophy, and brought most flattering praise to the author from contemporary students. In an animated style the disciple of Jean Jacques Rousseau, the apostle of bold and ingenious ideas, was already beginning to declare herself. In the meantime she collaborated on the journal The New Economist, which the historian and sociologist Pascal Duprat had just founded.*

At the close of 1860, the Canton of Vaud having opened a competition on the Principles of Taxation, "the little lady with a straw hat," as her neighbors familiarly called her, handled the subject so thoroughly that her memoir, entitled *Théorie de l'Impôt et Dime sociale* (Theory of the Impost and Social Tithe, 1862), won her the honor of dividing the prize with Proudhon. While not all the ideas set forth in this work were new, she took care at least to co-ordinate the systems of her predecessors, to select from the one and the other of them what was good in them, and to condense into a homogeneous whole works which were scattered hither and thither. But we will pass over these books of her youth to dwell more at large on that part of her work which will assure Madame Royer an honorable place among the most zealous promoters and ablest defenders of the Darwinian theories.

Her first effort in this line was to translate into French, in 1862, the Origin of Species of the great English naturalist, preceding the work with a preface which in itself alone constituted an excellent summary of the doctrine of evolution. She pointed out the results which logically follow from the transformist theory. She did not conceal from herself that in doing thus she would be the object of attacks from the immobilist and ecclesiastical parties still so numerous thirty years ago in all civilized countries; but she flattered herself, too, and with just reason, that she would furnish the liberals and progressives of France with a powerful weapon. In this introductory chapter she characterized the original and strong personality of Darwin in appropriate terms, saying: "While he has not the brilliant qualities of a Cuvier as a writer or a professor, he is at least a worthy heir of the profoundly philosophical science of the two Geoffroys Saint-Hilaire . . . one of those workmen who cut their stone with an

* Pascal Duprat, born at Hagetman (Department of the Landes), March 24, 1816, was professor of history at Algiers and at Paris. He took the direction of the *Revue indépendante* in 1847; founded with Lamennais the journal *Le Peuple constituant*, and was an ardent promoter of the Revolution of 1848. Having became a member of the National Assembly, he opposed the *coup d'état* of Louis Napoleon Bonaparte. Being obliged in consequence of this act to exile himself, he retired to Belgium and afterward to Lausanne. He did not return to France till after the war of 1870, and died in August, 1885. The most interesting of his works is the Historical Essay on the Races of Africa (*Essai historique sur les Races de l'Afrique*, 1845).

indefatigable courage. But there are also thicker and heavier stones, without beauty or apparent grace, which are designed to be hidden at the base of an immense edifice, like the massive columns with which the architects of the middle ages decorated the crypts of their Gothic cathedrals. It is truth in the rough. He does not impose his condition, but communicates it and proves it. If it is certain, he affirms it; when he supposes, he says so; when he doubts, he acknowledges it." She then passes to the exposition of Darwinism as responding to one of the noblest aspirations of the mind, the preliminary step to the accounting for the world of organized beings, as astronomy, physics, and geology have explained the origin of inanimate substances. In effect, the illustrious Englishman, connecting the domain of botany and zoölogy with the action of second causes, sought first to comprehend the genesis, and then the evolution, in the same way that astronomers and geologists teach us concerning the origin of our globe and the successive phases through which its surface has passed.

Not only did Madame Clémence Royer initiate us into transformism. In her masterly introduction she went still further. Carrying the exposition to its final consequences, she provoked a useful revolution in the ideas then current. She dared to say what many men of science would only have left to be inferred. Her translation, revealing the name of Darwin to the French public, who hardly knew of it at that period, gave the occasion for a very active conflict between the partisans of "creationism" and the Nantese philosophy. The success of this work was so great as to induce her to complete her preface by publishing a few years afterward a work wholly her own, *Origine de l'Homme et des Sociétés* (Origin of Man and Societies, 1870), which, being her best production, deserves a special analysis. With the assistance of documents collected by the most famous anthropologists, Madame Royer reconstitutes the history of the primitive ages of mankind, and after studying its origins and development she seeks for the bonds that connect the great human family with the rest of living Nature; and finally forecasts its future from its past.

In the first part she takes up the question of the origin of life and of its transformations upon the earth. The living species are grouped around man, who is the topmost shoot of the gigantic "tree of life." Two laws regulate the transmission of life—the law of heredity and the law of variability. The former assures the continuation of the type, and the latter variety in its modifications. The organic kingdom as a whole oscillates between these two contrary rules which fix limits each upon the other and which suffice to explain the successive appearance through the ages of different forms of life. The organic individual is thus the solution of a problem in algebra set to Nature. Atavism is the constant quantity, and the force of variation is the perpetually changing unknown factor. The problem is therefore complex, but the principles to which the variable is subject resolve themselves into a series of partial laws which are deduced from an aggregate of observations, and which, according to our author, one may summarize as he goes.

Most of the variations reveal themselves in the embryo during the fœtal period. But after its birth the young product is affected not only by the ambient medium, but also by the consequences of the reproductive act. The latter, in fact, having impressed the initial movement upon its organism, reacts incessantly against the modifying influences of the ambient, and atavism prevails as always the resultant unless important accidents come in to change the course.

It is only necessary to add a few experimental considerations to complete a rapid sketch of the laws of variability. First, correlation of growth: Homologous organs tend to vary in the same direction, and together. Are the fingers joined or divided? The hand follows similar variations. Then there is a compensation of growth which prevents the excess of the preceding rule; when one organ is developed, another is atrophied. Also vital competition. Every organized being must be in harmony with the conditions of its existence or it will not subsist; the monster may appear, but will not live. Lastly, by virtue of natural selection, the individual must likewise possess the means of perpetuating its species. Otherwise, a series of transformations will come to pass in the course of successive generations, improving the organism and adapting it more and more to the exigencies of its habitat. The least prolific species of to-day fulfill these conditions so well that they of themselves alone would cover the surface of the earth if their multiplication was not checked by that of other species. But as only a limited quantity of life is possible on our planet, the less well-adapted organisms perish. The struggle therefore produces a selection. It is hence presumed that in the same species only varieties manifesting tendencies in most complete harmony with the method of their existence will be preserved, all the intermediate varieties being destroyed. Consequently, if we push the doctrine of Darwin to its extreme limits, we arrive at the idea, now rejected, that in the beginning only a single germ arose at one point on the globe. All the analogies, on the other hand, lead us to suppose that the earth was fruitful over its entire surface.

This leads us to inquire how life appeared on the earth. The debate between the heterogenists and the panspermists has been long vain, because the question has been laid before them in insoluble terms. In order to resolve it, therefore, we must take ourselves back in thought thousands of thousands of centuries in the past. A thin crust of red-hot lava, hardly solidified, extended over the incandescent nucleus of our globe. An eternity then passed before the fiery sphere was forever confined within its coffin of granite. The metalloids dominant in this chaos of affinities and repulsions were then floating in an irrespirable atmosphere along with a mass of aqueous vapors. At the end of many millions of years, the waters definitely took their place around the globe. But who can ever tell what useless abortions, to be destroyed as soon as they were created, arose in these oceans saturated with anomalous substances? The first germs of life doubtless arose from the thick proliferous stratum which was developed under the pressure of a dense atmosphere in contact with liquids still warm, incessantly traversed by electric currents of unimaginable intensity. It was a sprout that arose everywhere at once. But in those innumerable spontaneous efforts, continued during the enormous length of time required to purify the atmosphere from its acrid vapors and the seas from their foreign matters, only a small number of these germs achieved a beginning of vegetation. This, according to Madame Royer's theory, was the way life began on the globe.

The author next examines the complete series of the phases of evolution gone through by the species, and then the development of the mental faculties, the chief feature of difference which in the view of some thinkers creates a gap between man and the rest of the animal kingdom. She demonstrates that the primary qualities of mind are identical in all living creatures, even in those of least development. The intelligence of man is simply superior to the mental organism of the animal. This is, however, only a relative superiority, not differing in nature from the animal's intelligence, but only in form and intensity.

After relating the history of man in prehistoric times, our philosopher gives, in the second part of her work, the present picture of the races as their physical characteristics and their social orders differentiate them so profoundly: At the top, the white race, the last flower of the genealogical tree, to which all the great nationalities belong. By the side of it, its two diverging branches, the Turanians (Hungarians, Finns, and Turks) and the Aramæans or Semites (Jews, Arabs, and Syrians). Then come the three—Hyperborean, Mongolian, and Sinitic—branches of the yellow stock, who inhabit eastern and northern Asia. We find also the Malays covering the surface of the two southern peninsulas of Asia and Oceania. They constitute a lateral ramification, which, together with the red or copper-colored race of North America, may have had the same point of departure as the Mongols. Lastly comes the negro race, which has been separated a much longer time from the common stock from which man has diverged.

Further on, Madame Royer discusses the anatomical relations of man and the ape, with the conclusion deduced as resulting from phenomena of observation that the human family is only a term in a series of which the different primates are the other steps. In short, the further we go back in the past of primitive man, the more we meet manifestations of passions as ferocious as base. This is, moreover, easily conceivable. The savage, at war with Nature and his like, and placed in conditions of life common to the animal world, has in the beginning all its bad instincts.

The end of the second part of *L'Origine de l'Homme et des Sociétés* is devoted to the most complex problem of anthropology—that of the beginning of speech and the origin of language. Man, in the view of the author, first makes his wants and feelings known to other beings by a series of signs. The three primordial faculties—feeling, thinking, and wishing—were the point of departure, the cause and the rule of all languages that man has created in his entire progress. As his mind has shaped a new idea, it has found a new sign to express it; but the process varying with the race, time and the environment have produced the diversity of tongues which we observe. In the beginning a more or less complicated cry suffices to express the thought in its original syncretism. Then, under the influence of reflection continued through ages, from generation to generation, it becomes transformed and decomposed into various elements. Every noun was primarily an adjective-substantive. For example, thunder was designated by imitating it; the horse, by its neighing and the sound of galloping. The relations of place, possession, and those of many other kinds were probably expressed by the look, the attitude, a motion with the hand, etc. Ideas of number were developed slowly. The earliest languages contained only about a hundred words, and these sufficed for centuries for the needs of human thought, confined within the narrow experience of a generation. It results from these facts that in every sense the formation of languages is a consequence of social relations. But here rises a question as important as difficult to answer: When did man begin to speak? From the harmony between the anthropological classifications deduced from philological research and those drawn from the labors of the physiologists it appears evident that the spontaneous and primitive constitution of the first elements of language was, among all known human races, posterior to their geographical and ethnical separation. In other words, local varieties had already been formed, and men had acquired the anatomical differences that distinguish them to-day before they conquered the faculty of speech. However it may be with these hypotheses, we may assent fully to the conclusion of the chapter that man will never deserve the name of the reasoning animal till he shall possess a logical and single language for all the members of the great human association. May this dream be realized by the destruction of the barriers which now divide so many peoples!

In the third part of the work, Madame Royer treats of the development of human society. Everything permits the supposition that from a very remote period the anthropoid primate that served as the root stock of man became omnivorous, with a predominance of carnivorous tastes. These conditions of life therefore invoked an at least rudimentary social instinct—that is, animals lived in troops collected under chiefs, with a tactics for mutual defense. The most ancient documents, in fact, show the human species living in rival or allied tribes. Hunting and fishing were the principal business of these primitive races, which relied for assistance at first on their agility, muscular strength, and arms of stone of a workmanship still in its infancy. Flint was then very roughly cut. But now a great advance was achieved for man, a step toward industry and civilization. This second stage was the discovery of fire, an immediate consequence of the cutting of flints, when sparks would fly out at each blow. Yet a later epoch probably had to be reached for the real employment of fire in cooking food. Previous to that it could serve man only for warming himself, or for protecting himself at night against wild beasts.

Next came the earliest industries—the potter's art, the making of rude clothing, and the construction of habitations; and about this time the instinct of property begins to develop. For a long time there are no other securities than force. On the other hand, the diversities of the faculties, which are very unequally distributed among the various races, and even among the different individuals of each of them, create social inequalities, the chief cause of the crime, wars, and misery with which every page of the history of man is soiled, and from which the original organization of civil society sprang.

At the close of her treatise the eminent anthropologist states the formula of the highest social prosperity: she believes that it resides in an equal liberty for each member of a national collectivity and in the free play of individual initiatives. Man will work in as large a sphere of action as the right of another leaves him, striving to broaden his place at the feast of life. Each one will climb the social ladder in his own way and will fix himself on the step on which his aptitudes will meet the best reward. Each individual will therefore gain a large sum of well-being, and the species will possess a total maximum of enjoyment.

Such, in broad outline, is the substance of this book, which naturalists and philosophers have consulted now for many years. It is not within the province of our sketch to dwell upon any of the bold assertions and hypotheses in it that have been invalidated by later geological discoveries; and, notwithstanding a few errors in detail, almost inevitable in a book of the kind, the *Origine de l'Homme* is, as a whole, a work as vigorously thought out as clearly and generously written.

Madame Clémence Royer has further occupied herself with special researches on subjects of the same nature. Their results have been published in the highly esteemed review, the Bulletin of the Société d'Anthropologie. The most important of these memoirs relate to the Craniology of the Quaternary Period, the Celts, the Origin of the Different Human Races (1873), and the Domestication of Monkeys (1887). The last work was published at the time of the appearance of a book by M. Victor Meunier,* a believer in the possibility of domesticating the simian race. His proposition, received in France as a kind of a joke, taxed the genius of the Parisian caricaturists, because the author had suggested that newborn children be nursed by monkeys, whose milk was most like that of the human mother. Of course it was an easy subject to joke about. Madame Royer showed how little originality there was in this book. We might, she said, undoubtedly succeed in educating monkeys, and they would at the end of many generations be in certain cases superior to the dog and the horse. Unfortunately, the struggle for existence opposed the adoption of the Utopian idea. The place for each human recruit at the social table is now too narrow for any part of it to be left for "our lower brethren."

Anthropological sciences were not the only ones to which the encyclopedic mind of our learned philosopher was attracted. A few years ago she returned to her earlier studies, and collaborated on the *Nouveau Dictionnaire d'Économie politique* of Léon Say (1891–'92). The most profound article she wrote for this work was that on the word positivism. According to it, the Positive Philosophy dates, not from Auguste Comte, who is believed to have introduced it, but from Bacon; for its essential features may be found in the *Novum Organum* and the *Scientia nuova*. Furthermore, Madame Royer found that Comte "emasculated" the doctrine of the famous chancellor. The principal dogma of the system is the impossibility of knowledge of first causes by our reason. This is an error, says Madame Royer. Two distinct ideas have been confounded in the term first causes: first, the permanent cause of phenomena, their essential "substratum," the discovery of which man may perhaps some day reach; and, second, the supposed primary term of each phenomenal law. But if the world is eternal, this last does not exist,

* Les Singes domestiques. Paris, 1886.

since "the eternity of the substantial involves the eternity of its effects." Yet, while she attacks Comte's errors in the sphere of sociology, she renders full justice to his Course of Positive Philosophy, which was often in advance of its time in respect to the exact sciences. Among other of Madame Royer's publications we may cite *Zoroastre, son Epoque et sa Doctrine* (Zoroaster, his Epoch and his Doctrine, two volumes, 1875); *Les Ages Préhistoriques* (The Prehistoric Ages, 1876); *La Terre et ses Anciens Habitants* (The Earth and its Ancient Inhabitants, 1891), a sort of summary of recent progress in paleontology, and of facts that may be derived from the study of living beings; and *Les Variations séculaires des Saisons* (Secular Variation of the Seasons, 1892), a little work in which the author endeavors to confirm by observation a theory that climatic variations are dependent, in the meteorological sense, on planetary movements. She showed, for example, that in the cold winter of 1879–'80 the distribution of the planets around the sun was precisely that which should give the greatest degree of cold for our hemisphere.

We notice also her occasional contributions to different periodicals: to *Le Temps*, the *Revue des Revues*, the *Journal des Économistes*, etc. Her last two treatises were published in 1895: *La Matière* (or Matter), and *L'Inconnaissable* (or The Unknowable).

So great intellectual activity has given Madame Royer a first place among women as students of science. Hence, on March 10, 1897, her numerous admirers and friends offered her a jubilee banquet, under the chairmanship of M. Levasseur, member of the Institute of France. The toasts spoken to on this occasion retraced the brilliant career of the heroine of the feast; and, as the chairman justly declared, the occasion was "the glorification of woman's knowledge." Madame Clémence Royer is at present living a very retired life in the *Maison de Retraite* founded by the Duchess Galigani at Neuilly, near Paris, where she enjoys the rest earned by a half century of persevering labor. Her body is feeble, but her ample brow and her yet lively eyes seem still to have preserved the recollections of the struggles of other days.

DR. SHELDON JACKSON, superintendent of Government schools in Alaska, corrects a report that has been published, that his experiment in naturalizing reindeer in that Territory has failed. Three hundred and twelve of the five hundred and twelve head imported died, it is true, at Seattle and Haines, "because of a combination of circumstances and Government red tape," but the two hundred and twenty-eight deer that were allowed to reach the moss, fifty miles from the coast, are doing well, and will be used next winter in carrying the mails. Instead of scarcity of moss, the pasturage is more abundant than in Lapland or Siberia, and the reindeer thrive better than they did in their native habitat.

Editor's Table.

WORDS OF A MASTER.

THE address, which we print elsewhere, delivered by Sir Archibald Geikie to the students of Mason College, Birmingham, is one to which we feel it a duty to draw special attention. It would be difficult, we think, to state more lucidly than the eminent author has done the advantages to be derived from a course of scientific study, and the principles which must be kept in view, not only during the period of study, but through life, if a training in science is to have its best results.

The address begins with a few words of caution as to the drawbacks which are apt to attend on the exclusive, or nearly exclusive, pursuit of science. In the reaction which the present age has witnessed against the old literary and linguistic curriculum of studies, a tendency is manifesting itself to undervalue the older learning. This Sir Archibald considers to be a matter for serious regret. He recognizes the impossibility of combining any large amount of literary or philological study with the requirements of an extensive scientific course; but he advises those who make choice of the latter to "cherish the literary tastes they have acquired, and to devote themselves sedulously to the further cultivation of them during such intervals of leisure as they may be able to secure." A training in science, he observes, "admirable as it is in many ways, fails to supply those humanizing influences which the older learning can so well impart." Times will therefore come, even to the most enthusiastic student, when "scientific work, in spite of its absorbing interest, grows to be a weariness"; and it is then that the value of any literary culture which may have been received at school or college will be appreciated.

It is a quite true remark that "men who have been too exclusively trained in science, or are too much absorbed in its pursuit, are not always the most agreeable members of society." It is also true that "one result of the comparative neglect of the literary side of education by many men of science is conspicuously seen in their literary style," which is not infrequently so "slipshod, ungrammatical, and clumsy that even the meaning of the authors is left in doubt." This is a great evil under the sun: a man goes through a vast amount of labor to ascertain facts and discover their meaning; and when he is ready to transfer the knowledge that he has gained to other minds he lacks the skill to do it in any satisfactory manner. Yet so far is it from being the case that there is any necessary incompatibility between scientific and literary cultivation, that several of the most distinguished scientific investigators have ranked among the best writers of the day. We need only cite such names as Sir John Herschel, Lyell, Darwin, Huxley, Tyndall, Clifford, and Sir Archibald Geikie himself: to read any of these is a pleasure from a literary no less than from a scientific point of view No very satisfactory excuse can therefore be made for those scientific writers who can not compass a style of reasonable perspicuity and elegance. We can only think of them as having fallen victims to the hurtful error that literary style is of no advantage to a scientific man.

The caution which the address contains against taking too utilitarian a view of science is timely and judicious. We do not believe the intention of the author is to encourage the prosecution of alleged scientific researches independently of all assignable human motive; but he would have all the main lines of scientific inquiry pursued in a liberal and disinterested spirit, in the belief that the enlargement of knowledge can not but subserve in some way or another, and sooner or later, the interests of the human race. He feels that the true scientific spirit is not one that makes pecuniary gain its chief object. True types of the scientic worker are to be found in Michael Faraday and the elder Agassiz, who was "too busy to make money"; and the student of science who can not to some extent work in the spirit of these men may as well recognize that it is not scientific truth he is after but money. The greatest advances in Science, it is almost needless to say, have been made by those who were serving her not for the lust of gain, but for the love of discovery—that is to say, by men like Copernicus, Galileo, Harvey, Cavendish, Newton, Franklin, Jenner, Watt, Darwin, and Pasteur; and if we would know what science is, it is the lives, characters, and labors of such men as these that we should study, and not the achievements of merely successful patentees.

Another danger to which the student of science is exposed is that of paying little or no attention to any department of science save that of which he is making a specialty. It is therefore of great importance that the courses of study laid out in science colleges should at the outset be sufficiently broad to afford a thorough grounding in the leading principles of all the sciences and in the application of scientific method to every field of inquiry. Only in this way can a true sense of the power and universality of science as a method of thought and an engine of the human mind be obtained. Why is it that we are often so little impressed with the intellectual character of this or that noted specialist? The reason, we take it, is that his mind lacks breadth; he knows his own field of observation, but seems to have little sense or appreciation of what lies beyond it. It may have been some one of this type who suggested to Wordsworth his idea of an "ever-dwindling soul"; certain it is that a man may, by the too exclusive pursuit of a narrow line of thought and inquiry, fatally cramp his mind and dim his spiritual vision.

The foundation of all science is observation, and Sir Archibald rightly dwells upon the supreme importance of cultivating and developing the observing faculty to the utmost extent. He states that a man may possess a colossal intellect while his faculty of observation may be of the feeblest kind, and gives as an example a very eminent mathematician, lately deceased, who used to make the most ludicrous mistakes as to time and place. Upon this point we feel like venturing a little dissent. We doubt whether there ever was a colossal intellect apart from a considerable development of the power of observation; and that a great mathematician should take very little notice of what was going on in the world about him would only show that his powers of observation were otherwise engaged. Take him in his own field, and what a multitude of things he would observe which a man of inferior intellect, occupied with the same studies, would overlook! It would be a somewhat rash thing to undertake to cure an Archimedes or a Newton of that absent-mindedness which, to the world at large, looks like a deficiency of observation. In such cases as these the mind that is absent here is present elsewhere; and what it is doing there the world will in due time find out. It is impossible, we hold, for any one man to be observant in all directions; if he is, it is certain he will not have a colossal intellect. Still, the truth which should be borne in upon every student's mind is that if he would make independent progress he must be an independent observer. He must take in once for all the truth that the materials needed for scientific construction lie afield, and that he must keep his eyes open in order to see and distinguish them. At every moment the man of science may say, "There are more things in heaven and earth than are dreamt of" in any philosophy yet formulated; and some of those things he should aim at discovering for himself. Any mind that is once thoroughly interested in any branch of study will be observant, and conversely a certain practice in observation may create an interest not before felt in a certain department of study. It may also be remarked that the dividing line between observation and deduction is very narrow and more or less shadowy; and therefore to cultivate the logical faculty is to create an appetite for observations, or at least for facts. The logical mind sees where facts are *wanting*, and will not be happy till it gets them.

As might be expected, Sir Archibald Geikie makes a special application of what he has to say on the need of observation to his own science of geology—a study which is a constant challenge to the observing eye and the constructive intellect. He dwells impressively on the delight which the rational contemplation of Nature imparts to the student whose higher faculties have been awakened, and who has been taught what to see and how to consider it. "The movements of the clouds, the fall of rain, the flow of brook and river, the changes of the seasons, the succession of calm and storm, do not pass before your eyes now as once they did. While they minister to the joy of life, they speak to you of that all-embracing system of process and law that governs the world." Certainly this capacity for the higher enjoyment of Nature is the happiest result of scientific culture; and were it an invariable or even a very general result, there could never be any question as to the humanizing and liberalizing effect of devotion to scientific studies. If the result in question is not always attained, it is simply because the study of science has not been approached in a right spirit. It is not science that is at fault.

Sir Archibald dwells finally on the need for *accuracy*, *thoroughness*, *breadth*, and *patience* on the part of those who would worthily pursue a scientific career. If his words were duly heeded we should have more of generous co-operation and sympathy among scientific investigators, and less of selfish petty rivalry and clamorous contention in regard to questions of priority. The eminent author has nobly conceived the character and function of the man of science in the present age; and we can not but hope that his sage and earnest counsels to the rising generation of scientific workers will bear abundant fruit in days to come.

FADS AND FRAUDS.

WE notice that a magistrate in a Canadian city has inflicted fines, under a "vagrant" act, upon two individuals who had been practicing the alleged art of palmistry. Both of these parties were proved to have told fortunes from the hand for pay; and, though one styled himself "professor" and the other was a "madame" and not a common wayside gypsy, they were both held guilty of common juggling and were punished accordingly. The public prosecutor said that he did not lay any stress on the fact that pay had been taken; he asked for a conviction simply on the ground that fortune-telling was against the law, and he carried his point. The judge observed that similar proceedings might be taken against young ladies who tell fortunes at church and charity bazaars; and the prosecutor admitted that such was very likely the case. These young ladies, he said, would have to look out for themselves.

We must say that this action on the part of the Canadian authorities strikes us very favorably, and we should be greatly pleased if we could see similar proceedings taken nearer home. It is a lamentable fact that hundreds of persons who ought to know better amuse themselves by lending their countenance to the practitioners of all kinds of silly and dishonest arts, and so far assist them in practicing their frauds upon a more ignorant and helpless class. We are all familiar with the stories which pass current in private circles of the extraordinary revelations and predictions made by ladies and gentlemen who go off in trances and see the past and future unrolled before their upturned eyes with all the distinctness of an actual panorama. But there is one thing which these interesting and highly gifted individuals do not like, and that is to get into the courts, or anywhere where they can be called upon to give a succinct and definite account of their doings and pretensions. They are not ambitious of going into a trance before the magistrate, and giving an exhibition of the powers to which they lay claim in their advertisements, much as that might be expected to help their reputation and their business. For that very reason it would be an excellent thing to bring them where the light of common day could be thrown upon their performances; and, if there is no law under which this could be done, our legislators, who make so many needless laws, might very well pass one, the general effect of which would be to enforce the responsibility of all persons publicly pretending to the possession of any kind of supernatural power. It would tend to cool the faith of even the most benighted dupes to see their favorite seer cutting a foolish figure before a judge who simply wanted to know what it really was for which he charged money. In the Canadian cases both operators, when they got into court, showed a great disposition to minimize their claims to any power of foretelling events by palmistry or otherwise, and so it would be in every similar case. It is one thing to deal with a gullible maiden who wants to know the color of her future husband's hair, and quite another to converse with the officers of the law.

Most of the frauds which have any continued success owe it, in part at least, to an undue faith in the personal integrity of the practitioner. It seems a rude as well as an unkind thing to suppose that So-and-so, whose demeanor is so modest and frank and simple, whose sentiments are so elevated, whose whole personality seems calculated to inspire confidence, is really an outrageous deceiver. In many cases people have said in effect that, if they had to choose between believing a miracle and doubting the veracity of this or that engaging individual, they would believe the miracle. Yet time and again the engaging individual has been proved to be an impostor, and the miracle has fallen to the ground. One of the most remarkable cases of the kind is furnished by the history of the Keeley motor, the absolutely fraudulent character of which has lately been brought to light. Keeley professed to transcend all the known laws of physics and mechanics, and he talked a jargon which all acknowledged to be unintelligible, but the unintelligibility of which was ascribed by his devotees to the fact that he was really working outside of known laws, and could not be expected to translate his ideas into the language of everyday science. In this way what was really an adjunct to the imposture he was practicing was counted as a proof of the truth of his ideas and the reality of his work. Yet now we know that the whole business was a matter of hidden tubes and wires and pulleys and double axles, one concealed within the other, with a water motor hidden under the floor. Thus it was that the "ætheric vibrations" and all the other mysterious phenomena were produced. We remember a sermon that was preached some years ago by an earnest divine, who professed to see in the alleged effects produced by Keeley an explanation of the miracle of the casting down of the walls of Jericho. Keeley would take his harmonium and, striking a certain chord, would cause his motor to revolve. In like manner Joshua with his trumpets and pitchers made precisely the kind of noise required to produce the ætheric vibrations necessary to level the walls of the beleaguered city—a wonderful case of the most advanced science coming to the support of a venerable religious tradition! Unfortunately, the walls of Jericho must now be got down in some other way, since it is proved that when Keeley worked the harmonium he also worked the bulb of an air tube placed under his foot in the floor. But Keeley was so honest a man, so devoted to his profound researches, so true a type of the indomitable experimenter, that it was impossible for his friends and admirers to doubt him, even when he spoke of "the sympathetic negative attraction of the triune polar stream."

The lesson of it all is—investigate! *investigate!* INVESTIGATE! The more honest a man is, the more he will court investigation. It is to the credit of humanity perhaps that so much reliance is placed upon estimates of personal character in these extraordinary cases; but where belief is demanded for anything that is absolutely beyond comprehension, character should be put out of court altogether, and the one question should be, What are the facts? In the Keeley case, unfortunately, men of science as well as others were among the deluded. They should have suspected fraud; at least they should have insisted on making such investigations as a suspicion of fraud would have suggested; and, if they were not allowed to make them, they should have refused all countenance to the business. As it is, many ignorant persons who lost money through Keeley's imposture will very properly cast blame on the presumedly competent mechanicians and physicists who went through the form of examining Keeley's apparatus and afterward spoke, however guardedly, of his extraordinary results. As an object lesson in regard to the need for uncompromising skepticism when facts which can not be accounted for on understood principles are presented for acceptance, the history of the Keeley motor should not soon be forgotten.

Scientific Literature.

SPECIAL BOOKS.

PROFESSOR *Bailey* shows, in his book on the *Evolution of Our Native Fruits*,* that the value of the native American species has not yet begun to be adequately estimated, and his narrative carries the conviction that the possibilities to be realized from their development are totally undreamed of. De Candolle made the astounding assertion, in his book on The Origin of Cultivated Plants, that the United States only yields as nutritious plants worth cultivating the Jerusalem artichoke and the gourds. "They had a few bulbs and edible berries, but have not tried to cultivate them, having early received the maize, which was worth far more." "And yet," Professor Bailey answers, "the American grapes have given rise to eight hundred domestic varieties, the American plums to more than two hundred, the raspberries to three hundred, and various other native fruits have a large progeny." Three motives, the author says, run through his book: An attempt to expound the progress of evolution in objects which are familiar and have not yet been greatly modified by man; an effort to make a simple historical record from unexplored fields; and a desire to suggest the treasures of experience and narrative which are a part of the development of agriculture. The studies of which the book is a fruit were begun more than ten years ago, and were pursued with original sources where they were accessible, and at the cost of much labor and travel. The story begins with the grapes. The cultivation of native grapes, which are singularly abundant and various in the wild condition, began after several attempts on the large and on the small scale to make foreign grapes profitable had failed. Nicholas Longworth, of Cincinnati, who did more than any other one man to promote it, sought for wine grapes. After several varieties had been tried with more or less success, the Catawba and the Concord were introduced, and the cultivation was established and became important, but no longer with wine-making as its chief object. Now we have a large variety of grapes—characteristic, finely flavored, and adapted to numerous uses in wines and desserts. Plums are mentioned in the early records nearly as frequently as grapes. There are five native types from which diverse varieties have arisen, the greater part of them of fortuitous origin. The native cherries have not yet been very hopeful of promise, except the dwarf species, which seem "destined to play an important part in the evolution of American fruit." Five types of native apples are known, from which a number of named and worthy varieties have arisen, by Nature's propagation, not man's; and the author anticipates great benefits to be derived from the very gradual and undemonstrative insinuation of native blood into the domestic sorts. The story of the cultivation of the raspberries, blackberries, dewberries, strawberries, gooseberries, currants, and mulberries tells of much patience and skill applied to the production of results in the benefits of which all may share, and which have undoubtedly added to the sum of human well-being. There remain still many fruits, the

* Sketch of the Evolution of our Native Fruits. By L. H. Bailey, New York: The Macmillan Company. Pp. 472. Price, $2.

improvement of which has hardly begun, and which offer a promising field for experiment—the persimmon. pawpaw, whortleberry, buffalo berry, barberry, and nuts. The whole history of the improvement of American fruit is interpreted by Professor Bailey as showing that in nearly every case the amelioration has come from the force of circumstances, and not from the choice or design of man, principally because foreign species did not do well and something adapted to American conditions had to be found. Yet much skill has been shown in recognizing the good qualities of the native species, and in giving them conditions favorable to improvement. For the future the author believes that the best results at the amelioration of any species are to be expected by working with the highly improved forms rather than with the original wild stock. We need, he says, a greater range of variation, more divergent and widely unlike varieties, and more incidental or minor strains of the most popular and cosmopolitan sorts. Professor Bailey finds the greatest satisfaction in his book in the record of the men who have been instrumental in introducing the improved fruits. No men have been greater benefactors to our country than these, who have done the equivalent of making two blades of grass grow where only one grew before, and have added to the healthful sum of pleasure and content.

As Professor Darwin truly says, a mathematical argument is, after all, only organized common sense; but, unfortunately, it is usually in such a highly organized form as to be beyond the intelligence of the average reader. In the present volume,* however, the author has wonderfully simplified a most intricate and difficult mathematical subject, and really seems to give some justification for the above generalization.

The first chapter of *The Tides* is devoted to defining them and describing methods of observation and study. The curious tidal movements in lakes, called *seiches*, which were first systematically studied by Professor Forel on the Lake of Geneva, are taken up in the second chapter ; an account of Forel's work is given, and the statement made that similar researches are now under way on other lakes, notably that of Mr. Denison on Lake Huron in this country. Tides in rivers, including an account of the curious tidal phenomenon known as a "bore," are next described, the laws governing their variation and the ways in which they differ from the tides of the open sea being carefully laid down. A brief historical chapter, containing some curious extracts from Chinese and Icelandic literature, is rather instructive anthropologically than tidally. The three following sections are taken up by a study of tide generating and modifying forces, and include an interesting account of the experiments made some years ago by Dr. Darwin and his brother, in an effort to measure tidal forces by means of the bifilar pendulum, which is now such an important agent in seismological investigation. Chapters IX and X give an account of the equilibrium, and the dynamical theories of the tide-generating forces, and are chiefly accounts of the devices by which mathematicians have endeavored to bring artificial order out of the actual chaos. The great complexity of this portion of the subject; the variety of forces operating to produce the tides, the sun, the moon, the earth's rotation, etc.; and the number of retarding and confusing elements, friction, interposed land masses, river

* The Tides; and Kindred Phenomena in the Solar System. The Lowell Institute Lectures for 1898. By George Howard Darwin. New York : Houghton, Mifflin & Co. Pp. 378. $2.

currents, air movements, depth of water, etc., render these theories practically valueless for use in tidal calculations.

In the following section Dr. Draper shows how, by means of Lord Kelvin's "harmonic analysis," which separates the tide-generating forces of each kind into a number of ideal components, results of practical value are obtained. In Chapter XIII a very ingenious instrument for tide prediction which has been in use for some time by the Indian Government is described. The recording part of the machine is simply a paper-wound drum, on which a pencil point makes a graphic record. When the tides of a given port are desired, it is only necessary to set the instrument according to the tidal components, obtained by harmonic analysis and the time chosen for the beginning of the tide table, and then start it at the proper moment. It takes about four hours to run off the tidal curve for a year. This curve is then measured, and the year's tide table readily made out. Dr. Darwin informs us that a very similar instrument is now in course of construction for the United States Government. The remainder of the work consists of a more detailed discussion of the various disturbing influences which interfere with the simplicity of tidal movements—displacement of the earth's axis, earthquakes, etc , a long discussion of tidal friction, a study of the laws of rotating liquid masses, the nebular hypothesis, and finally a chapter on Saturn's rings. The text in many places will be found difficult to understand by the general reader, despite the author's efforts to fully and simply explain every point, and it seems questionable whether a thorough discussion of tidal phenomena can be made simple enough for the layman's comprehension. The volume can not be read by any one, however, without instruction, and is much the best general discussion of tidal phenomena which we have seen.

GENERAL NOTICES.

The *Elementary Zoölogy* of *Frank E. Beddard* * contains an account of a few types selected from the chief groups of the animal kingdom, followed and accompanied by a consideration of some of the more general conclusions of biology. A type system has to be used, but the author has endeavored to obviate the great fault of that method—the liability of the students conceiving that the characters of the species selected for description are distinctive of a wider assemblage of forms—by emphasizing here and there the differences between allied groups. The question arises whether to begin with the higher forms and go down to the lower, which some authorities believe to be the course easier of comprehension by the student, or to follow the inverse method. The author prefers to begin with the lower forms and gradually work to the higher as the course having the undoubted advantage of presenting the facts in a logical sequence. He accordingly begins with the amœba and proceeds upward. The treatment is simple and lucid. Novelty has not been sought in the illustrations, though there are several new ones, but selections have been made from the best already drawn.

* Elementary Zoölogy. By Frank E. Beddard. New York: Longmans, Green & Co. Pp. 208. Price, 90 cents.

An Introductory Logic * grew out of the lectures of the author, Prof. *J. E. Creighton*, to undergraduate classes in Cornell University; is intended primarily as a text-book for students, and aims at being both practical and theoretical. The broad view is taken in the definition of the subject that logic is the science of thought, or the science that investigates the process of thinking; and the author expresses himself convinced

* An Introductory Logic. By James Edwin Creighton. New York: The Macmillan Company, pp. 392. $1.10.

that, in spite of some difficulties, formal logic is one of the most valuable instruments in modern education for promoting clear thinking and for developing critical habits of mind. To doubters of the advisability of attempting to include a theory of thought or a philosophy of mind in an elementary course in logic, Professor Creighton replies that psychology having differentiated itself from philosophy and become a "natural" science, no longer undertakes to describe all that the mind is and does. "It belongs to logic to investigate intelligence as a knowing function, just as it is the task of ethics to deal with the practical or active mental faculties." Logic must first be a science before it can become an art, but it can not be regarded as an art in the sense that it furnishes a definite set of rules for thinking correctly. What it can do is to show the method by which new truths have been discovered and the general conditions that must always be fulfilled in reasoning correctly. The treatment in the text follows the usual order, except that the author, keeping clear of artificial diction, writes in talking English that is easy to be comprehended.

There are no more vital problems in the evolution of society than those connected with the point of view, the outlook, of the great masses of the "working people." These people form the backbone, the potential energy of society; an acquaintance with their views of ethics and life, and manner of living, is of the utmost importance, not only *per se*, but especially because of the efficient direction which such a knowledge can give the attempts at improving these latter, and through them society at large. Mr. Walter Wyckoff has, apparently actuated by some such view as this, in combination perhaps with a desire for a novel experience, made a two years' trip across the continent, living chiefly among the lowest and most improvident class of manual laborers; making his own living by their methods, and, by means of the close contact, studying them from a vantage point of unusual value. The account of this expedition * is, as it could not fail to be, no matter who the traveler might have been, of great interest and value. But in Mr. Wyckoff's hands the story has an added attraction through the literary ability of the author. There is much material of practical scientific value in the volume; it should prove especially suggestive and useful to some of our charity organization workers who apparently find it so difficult to govern their work by reason rather than emotion. There are one or two rather unpleasant lapses, the most marked of which advertises in a Chicago police station Mr. Wyckoff's great linguistic attainments, but the work is generally free from this sort of weakness, and is on the whole very well worth reading for instruction as well as entertainment.

* The Workers: an Experiment in Reality. The West. By Walter A. Wyckoff. New York: Charles Scribner's Sons. Pp. 378. $1.50.

The *Manual of Determinative Mineralogy* of Professors *George J. Brush* and *Samuel L. Penfield* * is intended primarily to be used in the identification of minerals, and that purpose has been kept prominently in view. The present edition is a complete revision of Professor Brush's original work, the value of which and the estimation in which it is held by its constituency are attested by the fact that fourteen editions of it have been issued since it first appeared in 1874. A revision of the parts devoted to blowpipe analysis and the chemical reactions of the elements was published in 1896. To the present edition a chapter is added on the physical properties of minerals, devoted chiefly to crystallography, in which the endeavor has been made to present the subject as simply as possible. Importance has been attached to the description of those forms which are of most frequent occurrence, and the examples chosen to illustrate the different systems represent, as a rule, the simple forms that prevail in specimens of common minerals, while rare and complex forms are treated very briefly. The introduction of a large number of species since 1874 has made a complete rearrangement necessary in the analytical tables; and they have been so developed that tests for characteristic chemical constituents furnish the chief means of identification. Stress is laid upon the importance

* Manual of Determinative Mineralogy, with an Introduction on Blowpipe Analysis. By George J. Brush. Revised and enlarged, with entirely new tables for the identification of minerals. Fifteenth edition, first thousand. New York: John Wiley & Sons, pp. 312.

of determining the chemical constituents as a factor in securing accuracy in identification.

Demonstrator *G. S. Newth* opens his *Manual of Chemical Analysis* * with a protest against the thought of "doing" analysis without learning more than the minimum amount of chemistry, and against teaching and practicing it in such a manner as to degrade it to the level "of a purely mechanical and often unintelligible series of rule-of-thumb operations." He says he has done his best to make it "as little of a cram book as possible," and has endeavored "to teach analytical chemistry as well as analysis"—that is, the theoretical as well as the practical side of the subject. He begins with emphasizing the importance of the student making himself *practically* familiar with certain simple operations he will have to perform constantly, and gives clear, concise definitions of such terms as filtration, solution, evaporation, fusion, precipitation, ignition, etc., which relate to those operations. He condemns slovenly formulas and mechanical notes, but commends real notes of the student's own observations. In his treatment he excludes merely descriptive details that have no bearing on analysis; and in quantitative analysis, prefers describing fully a few typical methods and processes to covering much ground slightly.

The Ingersoll Lectureship at Harvard University is constituted on a legacy by Miss Caroline H. Ingersoll, carrying out the wishes of her father, George G. Ingersoll, for the foundation of an annual lectureship on the "Immortality of Man," to which no conditions as to doctrine or method of treatment are attached. The purpose of the lectures, or perhaps their operation, as defined by Prof. *William James*, is that out of the series may emerge a collective literature worthy of the theme. Professor James took as the special subject of his lecture † the answer to two objections to the doctrine of immortality: first, the absolute dependence of our spiritual life, as we know it here, on the brain; and the second relating to "the incredible and intolerable number of beings which, with our modern imagination, we must believe to be immortal, if immortality be true." To the former objection the author replies that thought is not a productive but a permissive or transmissive function of the brain; when the brain decays the sphere of being that supplied the consciousness is still intact, and the stream still goes on; to the second, that spiritual being is not as material being, that each new mind brings "its own edition of the universe of space" along with it, that there is no crowding or interference, and that the supply of individual life in the universe can never possibly exceed the demand.

The first number of *In Lantern Land*, a monthly journal "devoted to literature, the fine arts, the play, with some discussion of passing events," *Charles Dexter Allen* and *William Newnham Carleton*, editors, gives promise of a literary journal of elevated tone. It holds its aim to be unprejudiced and independent. (Published at Hartford, Conn., by Charles Dexter Allen, for one dollar a year.)

Mr. *Henry Carr Pearson* presents in his *Greek Prose Composition* (American Book Company, 90 cents) results of his own experience in the class room. The aim of the book is to combine study of the essentials of Greek syntax with practice in translating connected English into Attic Greek, and to afford convenient practice in writing Greek at sight. The work is in three parts: Part I, containing, in graded lessons, the principal points of Greek syntax, designed for use at the beginning of the second year's study of Greek; Part II, short simple English sentences modeled after sentences in Xenophon's Anabasis, for daily use in connection with reading of the text; and Part III, connected English prose, graded, also based on the Anabasis. Review lessons are introduced, and a Greek-English vocabulary is provided.

Mr. *James W. Crook*, in the introduction to his history of the development of *German Wage Theories* (Columbia University Studies in History, Economics, and Public Law), remarks upon the slowness with which political economy, and particularly the study of questions concerning wages, has advanced in

* A Manual of Chemical Analysis, Qualitative and Quantitative. By G. S. Newth. New York: Longmans, Green & Co., pp. 462. $1.75.

† Human Immortality. Two Supposed Objections to the Doctrine. By William James. Boston: Houghton, Mifflin & Co., pp. 70. $1.

Germany. Hardly any original work on wages is to be found there for half a century after the publication of Adam Smith's Wealth of Nations, although numerous text-books bearing upon the subject were issued —all for the most part only summarizing or slightly modifying the reasonings and conclusions of the English master. The conditions of economic life in the two countries were different, and the "industrial revolution was slow in developing on the Continent, and in Germany the old industrial order with its restrictions and conservative methods prevailed long after England had replaced the old with the new." These differences between the two countries may adequately account for the great disparity in theoretic development. And Germany is still largely dependent upon other countries in its discussions. In the present work, the chief object being to discover progress of thought on the subject, chronology had to be sacrificed, in some instances, to a logical treatment. Those writers are grouped who appear to show the largest number of points of contact, and this leads to placing all the German writers treated in two groups, in one of which a real unity of method and interest prevails, and Hermann is the most important center, while the other group includes van Thünen, Karl Marx, and Schulze-Gaevemitz, authors who do not belong together in the sense that the others do.

Among the articles in the *Columbia University Bulletin* for June, 1898, are those on the Department of History, the Preparatory Schools (by G. R. Carpenter), Columbia Non-Graduates (H. G. Paine), the Teaching of Anatomy (by George S. Huntington), and the second of Mr. H. A. Cushing's historical papers on King's College in the American Revolution.

The report of *Filibert Noth*, special agent of the Division of Forestry, on *Forestry Conditions* and *Interests of Wisconsin*, and the *Third Annual Report of the Chief Fire Warden of Minnesota, C. C. Andrews*, furnish many facts and suggestions of value to persons interested in the maintenance and protection of our forests.

D. Appleton and Company publish as one of their Home Reading Books *The Story of Rob Roy*, by *Sir Walter Scott*, condensed for home and school reading by Edith D. Harris. The editor of the series, Dr. W. T. Harris, furnishes a preface, pointing out the essential qualities of Scott's works on which their fame rests, and analyzing the features of Scottish and English life of the age to which they relate and which give these stories of the border their interest and charm. In explanation of the plan and reason of the present condensation, he says that "it has been found possible to condense the Waverley novels by omitting all lengthy descriptions of scenery, historical disquisitions on the times, and a few passages of dialogue and monologue that do not contribute directly to the progress of the story, or throw light upon the character of the persons who enter upon the scene. It is believed that by this method the interest is preserved intact, and that after a year's interval the story in its unabridged form may be read with as lively an interest as the youth will feel in reading this version." Price, 60 cents.

A paper, *Indices Ponderaux de la Crane* (Weight Indexes of the Brain), in the Bulletin of the Anthropological Society of Paris, comprises the results of a study of the weight and capacity of the brain, the weight of the mandible, and the cranio-mandibular and cranio-cerebral indices, etc., made upon sixty-four heads of animals by *George Grant McCurdy*, of New Haven, with the collaboration of M. *Nicolas Mohyliansky*.

The pamphlet embodying the *Proceedings of the Tenth Annual Session of the Association of American Anatomists*, held at Cornell University in December, 1897, contains a portrait and notice, with bibliography of the late Dr. Harrison Allen, the reports of the majority and the minority of the committee on anatomical nomenclature, and seventeen papers contributed by members of the association.

The *University Geological Survey of Kansas* is conducted under the authority of the Board of Regents of the State University, and has issued already several large and elegant volumes recording the operations and results of its work. The fourth volume, now before us, embraces the paleontology of the Upper Cretaceous, and is by *Samuel W. Williston*, paleontologist. Kansas is famous for its fossils, no equal area in the United

States, perhaps, presenting such varied and remarkable records of this kind. Yet, while the State has furnished much of interest to the sciences of geology and paleontology, the published accounts in these departments are confined to scattered and abstruse papers accessible only to the specialist. The present publication is an effort to put this knowledge, so far as the particular formation to which it relates is concerned, within the reach of students. Professor Williston has been engaged for twelve years in the study of the geology and paleontology of the State, having spent more than three years in field exploration, and has been eight years collecting material for his book, enjoying the advantage of access to the very important collection of the university. Much of the information is here published for the first time. The fossils of the western part of the State only are described in it, for the sole reason that more preparatory work has been done on them in the university in recent years; but other departments are in preparation and will appear in due course. The fossils described are birds, dinosaurs, crocodiles, mosasaurs, turtles, microscopic organizations, and invertebrates, all of the Upper Cretaceous.

In a paper on *The Relations of the People of the United States to the English and the Germans*, read before the Thursday Club of Chicago, Mr. *William Vocke* undertakes a defense of the Germans against a supposition that they are hostile to the United States. This is right, if the Germans need defense, which we doubt; but to give his thesis the shape of an attack on England, as is done in the paper, is unnecessary.

The account of the investigations conducted by Dr. *D. N. Bergey* under the supervision of Drs. J. S. Billings and S. Weir Mitchell, on the *Influence upon the Vital Resistance of Animals to the Micro-organisms of Disease, brought about by a Long Sojourn in Impure Atmosphere*, already referred to in the Monthly, is published under the Hodgkins Fund in the Smithsonian Miscellaneous Contributions.

The *Report of the United States National Museum* which we are called upon to notice is for the year 1895, and bears the signature of *G. Brown Goode*. It embraces accounts of the origin and development of the museum, its organization and scope, and its work in public education; reviews of the special topics in its operations for the year; synopses of the scientific work in various departments; the administrative reports; appendixes relating to accessions to the collections, lectures, meetings, etc.; and a number of special papers of great value and interest, including an account of the Kwakiutl Indians, by Franz Boas; The Graphic Art of the Eskimos, by W. J. Hoffman; The Geology and Natural History of Lower California, by G. P. Merrill; The Tongues of Birds, by F. A. Lucas; The Ontonagon Copper Bowlder in the United States Museum, by Charles Moore; The Antiquity of the Red Race in America, by Thomas Nilsen; and accounts of the Mineralogical Collections in the Museum, by Wirt Tassin, and of the Taxidermical Methods in the Leyden Museum, Holland, by Dr. Shufeldt.

The Dawn of the Twentieth Century is a poem, described by the author, *Charles P. Whaley*, as his first sermon, dedicated to rationalism. He describes himself as having recovered from "a severe attack of orthodoxy," which deprived him for the time of the power of logical reason, and to have at last discerned a theology, "founded upon absolute, demonstrable scientific facts," which is to prevail in the next century. His poem presents his view of that theology.

In the September number of the Quarterly Review, *The New World*, an article by Prof. *Otto Pfleiderer* on Evolution and Theology, defines the task of Ecclesiastical Protestantism after having abandoned the ethical ideals of mediæval Christianity, as being "for a still wider development, to strike off the dogmatic fetters of ecclesiastical criticism, and to clothe its religious principle in new forms of thought, which shall render for our age the same service that the Greek and Roman dogmas rendered for the earlier time." In an article on Social and Individual Evolution, Mr. *Henry Jones* maintains that the social tendencies of the present day point to a limitation of individual independence and enterprise.

A contribution to the anthropology of the Jesup North Pacific Expedition, *Facial Paintings of the Indians of Northern British*

Columbia, by *Franz Boas*, forms the first part of Volume II of the Memoirs of the American Museum of Natural History. The Jesup expedition has been organized under the patronage of Mr. Morris K. Jesup, president of the museum, and under the direction of that institution, to study what relations may exist or may have existed between the natives of the northwest coasts of America and the peoples of the neighboring Asiatic coasts. The general likeness, in the midst of their special minor diversities, of all the Indians of the American continent points to an ultimately common origin for them, while the differences indicate that this may not have been precisely identical in time and place, and seem to have required a very long time for their development and establishment. The purpose of the expedition is to collect all the information that can be obtained by its method of exploration contributing to this end. The present contribution embodies the fruits of a study of the arts, as applied to facial decoration, of the Thompson River Indians, the Chilcotin, the Bella Coola, the Kakiutl, and the Nootka. This art is almost exclusively based on animal motives, is highly conventionalized, and has the unique peculiarity of seeking to fit the whole figure of the animal to the surface on which it is applied; whence it presents some curious effects. In this effort to illustrate the principles of its conventionalism Dr. Boas has selected as the most difficult and complicated surface the human face, of which he gives in six plates eighty-eight figures of as many different styles of decoration.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Bulletins and Reports. Cornell University: No 154. Tables for Computing Rations for Farm Animals. By J. L. Stone. Pp. 20; No. 155. The San José Scale. By H. P. Gould. Pp. 12; No. 156. Potato Culture. By I. P. Roberts and L. A. Clinton. Pp. 12; No. 157. The Grapevine Flea Beetle. By M. V. Slingerland. Pp. 24; No. 158. Bacteria in Cheese Curd. By V. A. Moore and A. R. Ward. Pp. 20, with plate; No. 159. Report on Progress of Work. Pp 32.—Hatch Station of Massachusetts Agricultural College: No. 56. Concentrated Feed Stuffs. Pp. 24.—New Jersey: No. 132. Fertilizer Analyses. Pp. 61.—Ohio: Seventeenth Annual Report for 1898. Pp. 48.—Purdue University: No. 73. Tests of Strawberries, Raspberries, Blackberries, and Grapes. Pp. 16; No. 74. A Native White Bedding Plant (Starry Grasswort). By J. C. Arthur. Pp. 12.—United States Department of Agriculture: No 16. The Hessian Fly in the United States. By Herbert Osborn. Pp. 60, with plates; Miscellaneous Results of the Division of Entomology. Pp. 102.—University of Wyoming: No. 39. Alkali Studies. By E. E. Blosson and B. C. Buffum. Pp. 24.

Allen, Alfred H., and Leffmann, Henry. Commercial Organic Analysis. Third edition. Revised. Vol. II, Part I. Philadelphia: P. Blakiston, Sons & Co. Pp. 387. $3.50.

American, The, Kitchen Magazine. A Domestic Science Monthly, January, 1899. The Home Science Company, Boston, Mass. Monthly. 10 cents. $1 a year.

Bailey, L. H., Editor. The Principles of Agriculture. New York: The Macmillan Company. Pp. 300. $1.25.

Bardeen, C. W. Commissioner Hume. A Story of the New York Schools. Syracuse, N. Y.: C. W. Bardeen. Pp. 210. $1.25.

Bates, Frank Greene. Rhode Island and the Formation of the Union. New York: Columbia University (Studies in History, etc.). The Macmillan Company. Pp. 220.

Brooks, William Keith. The Foundations of Zoölogy. New York: The Macmillan Company. Pp. 339. $2.50.

Bulletins, Reports, etc. Atlanta University: Some Efforts of American Negroes for their own Social Betterment (Report of the Third Atlanta Conference). Pp. 66.—Bruner, Lawrence, University of Nebraska: Some Notes on Nebraska Birds. Pp. 178.—City of Chicago: Report of the Educational Commission. Pp. 248.—Connecticut: Fourteenth Annual Report of the State Bureau of Labor Statistics. Pp. 234.—Harvard Astrophysical Conference, August, 1898. By M. B. Snyder. Pp. 33.—Harvard College Astronomical Observatory: Annual Report of the Director to September 30, 1898. By E. C. Pickering. Pp. 14.—Iowa State University: Bulletin from the Laboratories of Natural History, Vol. IV, No. 4. Pp. 96, with plates.—Jewish Training School of Chicago: Ninth Annual Report. Pp. 45.—Michigan: Thirtieth Annual Report of Registry and Return of Births, Marriages, and Deaths for 1896. By C. L. Wilbur. Pp. 18.—Model, the Gas and Gasoline Engine. Garrett Works, Indiana. Pp. 22.—New York State Museum: A Guide to the Geological Collections. By F. J. H. Merrill. Pp. 156, with plates.—Society of American Authors: Monthly, January, 1899. Pp. 12.—Tokio, Japan, Imperial University Calendar. Pp. 250, with map.—United States Commissioner of Education: Report for 1896-'97, Vol. II. Pp. 1260.—United States Fish Commission Bulletin, Vol XVII, 1897. George M. Bowers, Commissioner. Pp. 436.

Campbell, D. H. Lectures on the Evolution of Plants. New York: The Macmillan Company. Pp. 319. $1.25.

Clinical Excerpts. Vol. I, No. 10. Pp. 16.

Coming Age, The. A Magazine of Constructive Thought. B. O. Flower and Mrs. C. K. Reifsinder, Editors. Vol 1, No. 1, January, 1899. Boston: The Coming Age Company. Pp. 122. 20 cents. $2 a year.

Dabney, Charles W., Jr. University of Tennessee. The Old College and the New. Pp. 16.—A National Department of Science. Pp 13.

Elliott, A. G., Editor. Gas and Petroleum Engines. Translated and adapted from the French of Henry de Graffigny. New York: The Macmillan Company. 75 cents.

Farrington, E. H, and Wall, F. W. Testing Milk and its Products. Madison, Wis.: The Mendota Book Company. Pp. 256, $1. Pp. 110, 75 cents.

Haeckel, Ernst. The Last Link in our Present Knowledge of the Descent of Man. New York: The Macmillan Company. Pp. 156. $1.

Huntington, Harwood. The Yearbook for Colorists and Dyers. Vol. I. New York: The

Author. Pp. 309.—Some Notes on Chemical Jurisprudence. 260 West Broadway, New York. Pp. 24. 85 cents.

Index, The. Devoted to the Latest News and Gossip in the Field of Art and Letters. G. B. Rogers, Editor. Vol. I, No. 10. Cleveland and New York: The Hellman-Taylor Company. 50 cents a year.

Lee, Sidney, Editor. Dictionary of National Biography. Vol. LVII. Tom to Tytler. New York: The Macmillan Company. Pp. 461. $3.25.

Luquer, L. M. Minerals in Rock Sections. The Practical Methods of Identifying Minerals in Rock Sections with the Microscope. New York: D. Van Nostrand Company. Pp. 117.

Marr, J. E. The Principles of Stratigraphical Geology. New York: The Macmillan Company. Pp. 304. $1.60.

Martin, H. Newell. The Human Body. Fifth edition. Revised by G. W. Fitz. New York: Henry Holt & Co. Pp. 408. $1.20.

Mervan, Rencelof Ermagine. What is This? Copyrighted by G. Washington Price. Pp. 273.

Morehouse, G. W. The Wilderness of Worlds. The Evolution of Matter from Nebula to Man and Return. New York: Peter Eckler. Pp. 246.

Nichols, E. L., and Franklin, W S. The Elements of Physics, Vol I. Mechanics and Heat. New edition, revised, with additions. New York: The Macmillan Company. Pp. 219. $1.50.

Ober, Frederick A. Puerto Rico and its Resources. New York: D. Appleton and Company. Pp. 282, with map.

Ratzel, Prof. Friedrich. The History of Mankind. By A. J. Butler. Introduction by E. B. Tyler. Vol. III. New York: The Macmillan Company. Pp. 599, with maps. $4.

Reprints. Andrews, General C. C. Utilization of Our Waste Lands for Forestry Purposes. Pp. 10.—Bailey, Prof. E. H. S., Lawrence, Kan. The Proof of the Law of Similia (Homœopathic) from the Electro-Chemico Physiological Standpoint. Pp. 8.—Bangs, L. Bolton, New York. Illustrative Cases of Prostatitis. Pp. 24.—De Courcy, J. Osborne, East St. Louis, Ill. Diseases of the Alimentary Canal, Ulcers, Malignant Sore Throat. Pp. 24.—Gilbert, G. K., Washington Recent Earth Movements in the Great Lakes Region. Pp. 50.—Kakels, Sara W. Pregnancy in Women with Uterus Duplex.—Mayfield, R. N., New York. Catheters and Cystitis. Pp. 3.—Rotch, A. Lawrence. The Exploration of the Free Air by Means of Kites at Blue Hill Observatory, Massachusetts. Pp. 10.

Sladen, Douglas, Editor. Who's Who? 1899. An Annual Biographical Dictionary. Fifty-first year. New York: The Macmillan Company. Pp. 1014. $1.75.

Smithsonian Institution. Adler, Cyrus, and Casanowicz, I. M. Exhibit of Biblical Antiquities at the Cotton States Exposition, Atlanta, Ga., 1895. Pp. 87, with plates.—Clark, Hubert L. The Feather Tracts of North American Grouse and Quail. Pp. 12, with plates.—Langley, S. P. Report of the Secretary for the Year ending June 30, 1898. Pp. 89.

Starr, Frederick. American Indians. Boston: D. C. Heath & Co. Pp. 227. 45 cents.

Stewart, Freeman. Shall we Grow the Sugar we Consume? Swarthmore, Pa.: R. S. Dare. 25 cents.

Thompson, Sylvanus P. Michael Faraday: His Life and Work. New York: The Macmillan Company. Pp. 308. $1.25.

Whitaker, Herbert C. Elements of Trigonometry, with Tables. Philadelphia: Eldridge & Brother. Pp. 196.

Wilson, L. L. W. Nature Study in Elementary Schools. First Reader. New York: The Macmillan Company. Pp. 253. 35 cents.

Fragments of Science.

Pre-Columbian Musical Instruments in America.—In a recent article in the Popular Science Monthly (November, 1898), entitled Was Middle America Peopled from Asia? I insisted that if there had been any invasion, peaceful or otherwise, sufficient to have affected even in the slightest degree the arts, customs, and religious beliefs of middle America, then, associated with these influences, we should find traces of Asiatic utensils, implements, structures, such as sandals, weapons, pottery, wheels, plows, roofing tiles, etc.; in other words, just those objects most intimately associated with man. I especially considered the absence of stringed musical instruments and coincided with Dr. Otis T. Mason in the belief that there was no evidence of a pre-Columbian stringed musical device. This question has been variously discusssd and the following references bear on the subject: A short note in the American Antiquarian for January, 1897, by Dr. D. G. Brinton, entitled Native American Stringed Musical Instruments. The author frankly admits, however, that the cases cited may all have been borrowed from the whites or negroes. Mr. M. H. Saville in the American Anthropologist for August, 1897, described A Primitive Maya Musical Instrument, though he makes no pronounced statement of its pre-Columbian origin. Dr. Mason, in the American Anthropologist for November, 1897, discusses the question under the title Geographical Distribution of the Musical Bow, and in this paper says, "I have come to the conclusion that stringed musical instruments were not known to any of the aborigines of the western hemisphere before Columbus." In my paper I insisted that "had this simple musical device been known anciently in this country, it would have spread so widely that its pre-

Columbian use would have been beyond any contention." Mr. Saville finally, in the American Anthropologist for September, 1898, shows apparently the existence of a pre-Columbian stringed musical device in a paper entitled The Musical Bow in Ancient Mexico, and presents his proof in the form of a reproduction from an ancient Mexican codex of an orchestra of six performers. One of the figures, according to Mr. Saville's interpretation, is holding a musical bow in his left hand while with his right hand he is striking the cord with a forked stick. Claiming no skill in the interpretation of these quaint and concentrated Jack-of-heart figures, I readily yielded to the authority of Saville in this matter, and so acknowledged in a footnote in my paper which I was enabled to insert after the pages were made up. Within a few days I have received a letter from Mrs. Zelia Nuttall, the eminent American paleographist, to whom we are indebted for the most profound researches in connection with these ancient codices. In this letter Mrs. Nuttall refers to Sahagun's great manuscript, wherein she says: "The native musical instruments are repeatedly enumerated. The turtle's shell figures among them, *but there is no trace of a stringed musical instrument ever having been known or employed in ancient Mexico.*" (The Italics are hers.) Mrs. Nuttall then says that the object held under the arm of the musician which has been recognized as a musical bow is undoubtedly a turtle's shell. In support of this view she sends me a tracing of the figure from the original manuscript which is now in Vienna, in which the entire object under the arm of the player as well as the forked stick is colored blue (Fig. 1). A photograph is also inclosed from another ancient Mexican manuscript in course of publication by Mrs. Nuttall. In this (Fig. 2) the player has the turtle's shell and is pounding on it with a pronged stick, horn, or branch, while in the other hand he holds a rattle and at the same time sings, the notes being graphically portrayed as they come from his mouth. It will be observed that it is the plastron or ventral surface that he is striking, as shown by the notches in its forward and hinder edges, though the plates are incorrectly drawn. In the figure given by Mr. Saville the player is holding the turtle's shell in precisely that position that would enable him to strike the plastron. Even in Mr. Saville's figure the marginal plates of the shell are plainly indicated. By holding the figure face downward the shell is thrown in a normal position with the back uppermost, and what was mistaken for the string of the instrument is the outline of the back of the turtle correctly delineated. With the above figures I give the outline of the left arm and body of a friend who posed for me while holding a large South American turtle under his arm. I have drawn the plates of the carapace to more clearly indicate the posi-

FIG. 1.

FIG. 2.

FIG. 3.

tion of the turtle's shell. In the original codex, as before remarked, this portion is colored blue. In this attitude the flat plastron forms the drumhead, so to speak, the carapace acting as a resonator. I am sure that Mr. Saville will agree with me that Mrs. Nuttall's attribution is the correct one.

EDWARD S. MORSE.

Rebreathed Air as a Poison.—The following extracts are taken from an article by Dr. John Hartley, in the Lancet: "The fresh-air treatment of consumption" appears to be made up of three essential factors: (1) the discontinuance of the supply of bacilli from without; (2) the supply of an abundance of nutritive material to the tissues; and (3) the supply of an abundance of fresh air uncontaminated by the products of respiration. This seems to mean that the tissues, if not too enfeebled, may be trusted to deal with the bacilli already present if their metabolism is kept going at high pressure. Fresh air is now the "official" remedy in the treatment of tubercle. Why is it so ignored in the case of other diseases? Has the pneumonic or bronchitic no need of special ventilation because his microbe is of a different breed? The air was intended not only for phthisical patients or patients suffering from pneumonia but for *all*—diseased and healthy alike—and it is still the natural medium in which the poisonous products of tissue metabolism excreted by the lungs are further broken down and rendered harmless. Dr. A. Ransome has done great service not only by his onslaught on "air sewage" but also by his coinage of the term; for a thoroughly good opprobrious epithet resembles a good wall-poster in its power of arresting and enchaining the attention of the many. It was long ago pointed out that certain constituents of expired air are intensely powerful nerve poisons. These considerations should surely make us look on rebreathed air and sewer gas, not as mere carriers of accidental poisons, such as influenza and pneumonia and the like, but as *poisons per se*, and I wish to be allowed to record a few very imperfect observations made by myself during some years past chiefly on the subject of rebreathed air, with certain inferences which I think tend, however feebly and imperfectly, to show that the poisons we expire have *per se* very definite effects on tissue metabolism and need not a mere perfunctory admixture with fresh air but very large and very continuous dilution before they are rendered innocuous—that is to say, innocuous to *all;* for while some persons appear to be almost immune, others seem intensely susceptible. The first observation I will allude to was made in the autumn of 1896, in cool weather. I had to take a long night journey by rail after a long and hard day's work. The train was full and the compartment I entered was close; so, as I was tired and fagged, I sat in the corridor by an open window, well rugged up, throughout the journey. The compartment was completely shut off from the corridor by a glass door and windows, through which I could freely inspect its occupants. Two remarkably fresh-complexioned, wholesome-looking young fellows got into the compartment at York. They formed a remarkable contrast to the pallid and fagged-looking travelers already there. The windows and ventilators were carefully closed, and the newcomers, with the rest, settled off to sleep and slept soundly for nearly four hours, with the exception of a few minutes' interval at Grantham. When aroused on nearing London they, like the other occupants of the compartment, were haggard and leaden-hued, their fresh color was entirely gone, and they looked and moved as if exhausted. I examined my own face in the lavatory mirror at the beginning and end of the journey and could see but little alteration in my color; if anything, it was rather improved by the end of the journey. The second case occurred early in 1897. I was asked to see a woman, aged about forty-eight years, who had been treated in a neighboring town for many weeks for bronchitis and asthma following influenza. She had relapsed about a week when I first saw her. She was then sitting up in bed; her face was leaden-colored, her skin was clammy and sweating, with a feeble, quick pulse, and the heart sounds were indistinguishable owing to wheezing; there was some crepitation at the bases. The temperature was about 101° F. The weather was cold, but after wrapping her up, with a hot bottle to her feet, the window was well opened. Her color improved in a few minutes and the sweating ceased soon after. But it and the blueness returned if the window was shut for any time. It was directed to be kept open night and day, and I could see from my house that this order was carried out. Although on one night the thermometer showed 14° F. of frost the chest was clear of noises and she was convalescent in eight days. If fresh air needs warming she ought to have died. Why do most men feel so tired after an afternoon's work in a crowded out-patient room? Why is a long journey in a full railway carriage, even with a comfortable seat, so exhausting to many people? Personally an hour or two in a full carriage with the windows shut will give me numbness in my feet and legs and knock me up for the day, while a railway journey in an empty carriage with open windows does not affect me at all. But most people will be willing to admit that any kind of crowd is tiring. It is to me difficult to resist the impression than an overdose of waste products, whether of one's own or other people's, must generally interfere with the metabolism of nerve tissue. Women as they grow older are apt to live much indoors. I believe the fat, flabby, paunchy woman, whether purple or pale, with feeble, irritable heart and "inadequate" kidneys, is usually the victim of rebreathed air. A "close" room will infallibly give me an abdominal distention and borborygmi within half an hour, and I am inclined to think the purity of the air breathed by the dyspeptic quite as important as his regimen or his teeth. It must, I think, sooner or later be recognized that many of the increasing ills which it has been the fashion to charge on the "hurry and brain fag" incidental to a high state of civilisation and a large population are in reality due to the greater contamination of the air we breathe by the waste products of that population, and that toxines excreted by the lungs will in time take high rank among these as both potent and insidious. If this should come to pass, the present ideas anent ventilation must be abandoned as utterly futile, and the need will be felt, not of letting a little air in, but of letting waste products out.

The Utilization of Wave Power.—The utilization of the energy which goes to waste in the movement of water, in waves, tides, and waterfalls, has been a much-studied problem during recent years. The only one of these three phenomena which has as yet been at all extensively commercially harnessed is the waterfall. There have, however, been a number of wave and tide motors constructed. The most recent and perhaps the most promising of these is the type invented by Mr. Morley Fletcher, of Westminster, England. He has made a special study of the problem of motion of the sea, and has already successfully constructed a hydraulic pump, an electric motor, and a self contained siren buoy in which the energy is obtained entirely from wave motion. The great possibilities in this direction for cheap and efficient power plants have not been appreciated by sea-coast towns, but it is stated in Industries and Iron, from which we have taken the above particulars, that Mr. Fletcher is at present devoting his attention to devising schemes and designing apparatus for pumping sea water for shore purposes, ore washing, driving electric machinery for town lighting and power plants, buoys for marking harbors with beacons and fog horns, and the many other purposes to which such a constant and inexhaustible source of energy is applicable.

Dispersal of Seeds.—Having described in the Plant World some of the provisions of Nature for the dispersal of seeds, Prof. W. J. Beal adds that these various devices, besides serving to extend and multiply the species and promote its plantation on favorable soil, enable plants to flee from too great crowding of their own kind and from their plant rivals and parasites. "The adventurers among plants often meet with the best success, not because the seeds are larger or stronger or better, but because they find for a time more congenial surroundings. Our weeds, for instance, are carried for long distances by man and by him are planted in new ground that has been well prepared. Every horticulturist knows that apples grown in a new country, if suitable for apples, are fair and healthy, but the scab and codling moth and bitter rot and bark louse sooner or later arrive, each to begin its peculiar mode of warfare." So with peach trees and plums and their enemies. The surest way to grow a few cabbages, radishes, squashes, cucumbers, and potatoes is to plant them here and there in good soil at considerable distances from where any have heretofore been grown. "For a time enemies do not find them." Pear trees planted scatteringly are more likely to remain healthy than in orchards. "Perhaps one reason why plants have become extinct or nearly so is their lack of means of migration. As animals starve out in certain seasons when food is scarce, or more likely migrate to regions which can afford food, so plants desert worn-out land and seek fresh fields. As animals retreat to secluded and isolated spots to escape their enemies, so many plants accomplish the same thing by finding the best places with some of their seeds sown in many regions. Frequent rotations seem to be the rule for many plants when left to themselves in a state of nature. Confining to a permanent spot invites parasites and other enemies and a depleted soil, while health and vigor are secured by frequent migrations."

Commensals.—Curious associations are formed among animals for mutual aid in the struggle for existence. Some of them are societies of the same species, like those of ants and bees; colonies in which many individuals—as ascidians and bryozoa—join into a single mass and act as one; and associations of animals of different species constituting commensalism where both are benefited, or parasitism, when the advantage accrues to only one of the parties. The hermit crab and certain ascidians furnish very fine examples of commensalism. The hermit crab is known as an inhabitant of shells bereft of their proper owners. Some sea anemones also fasten themselves on shells, and seem to prefer those which have been adopted by hermit crabs. The association is shown by M. Henri Coupan, in *La Nature*, to be one of mutual benefit. The actinia defends the crab and its home against all intruders by means of its tentacles—veritable batteries of prickly stings; while the crab, with its long claws reaching out to catch whatever is good to eat, brings food within reach of the ascidian. Mr. Percival Wright, having taken the crab from a shell to which an ascidian had attached itself, found that the latter abandoned the shell in a short time. M. L. Faunt reversed the experiment, taking the ascidian away, when the crab deserted its quarters, found a shell with the ascidian on it, and occupied it very quickly. He further observed the maneuvers executed by the crab to secure the attachment of an ascidian to its shell. Sometimes a large ascidian will wholly cover a shell; or several smaller ones will spread themselves over the same shell so as to form a continuous envelope over it. The ascidians become so attached to their commensals as to seem unable to live without them, and even to die soon after being separated from them.

Drift of Ocean Currents.—Of sixteen hundred and seventy-five floats bearing requests to the finder to return them which Prince Albert of Monaco dropped into the Atlantic during three research cruises, with a view to learning something of the movements of surface currents, two hundred and twenty-six were returned to him up to the year 1892. By working the course which each of them had probably been following, the prince undertook to draw a definite map of the currents. As the elements employed were always numerous for each region, he thinks his results were near the truth in its general lines. The floats landed on almost all the shores of the North Atlantic, from the North Cape to the south of Morocco, along Central America, and on the islands of Canaries, Madeira, Azores, Antilles, Bermudas, Shetland, Hebrides, Orkneys, and Iceland. None appeared as far south as the Cape Verd Islands. The drifts seem to indicate an immense vortex, beginning toward the Antilles and Central America with the Gulf Stream and the equatorial current; passing the Banks of Newfoundland at a tangent, it turns to the east, approaches the European coasts, and runs southward from the English Channel to Gibraltar, after having sent a branch running along the coast of Ireland and the coast of Norway as far as the North Cape. It then returns to the west, encircling the Canaries. Its center oscillates somewhere to the southwest of the Azores. The author's observations enabled him also to establish a very good average for the speed at which these floats traveled in the different sections of the vortex, and for every twenty-four hours: Between the Azores, France, Portugal, and the Canaries, it was 5.18 miles; from the Canaries to the Antilles, the Bahamas, and as far as the Bermudas, 10.11 miles; from the Bermudas to the Azores, 6.42 miles. The mean speed for the North Atlantic was 4.48 miles. The figures are under rather than above the truth.

Winds of the Sahara.—Some interesting meteorological observations, made in the Sahara during eight excursions between 1883 and 1896, have been published by M. F. Foureau. The most frequent winds are those from the northwest and the southeast. Every evening the wind goes down with the sun, or goes to bed, as the Chaambe express it; except the northeast wind, which the Arabs call *el chitâne*, or the devil, because it blows all night. Another wind, called the *chihithi*, has been mentioned by all travelers, and is the subject of numerous legends. It is a warm wind from the southwest, charged with electricity, and often carrying fine sand and darkening the atmosphere. The compasses are much disturbed by it, because, it has been suggested, of a special condition produced upon thin glass covers by the friction caused by the rubbing of the fine wind-carried sand upon them; but it has been observed that the spare compasses show the same disturbed condition as soon as they are taken out of their boxes. The disturbance ceases when the glasses are moistened, and does not appear again till they have dried. Several hailstorms were noticed, the hailstones being usually about as large as peas, but larger in the heavier storms. M. Foureau, not having gone as far as the central heights, observed no snow in the Sahara, but was informed that snow falls in the winter on the tops of the *Tassili des Azdjer*, about five thousand feet above the sea. Similar observations have been made by other travelers, and falls of temperature to about 21° F. have been noticed. Very curious mirage phenomena were sometimes observed. Observations of fulgurites, or instances in which the sand had been vitrified by lightning strokes, were not infrequent.

Evolution of Pleasure Gardens.—A lesson in the evolution of pleasure resorts is suggested in a book by Mr. Warwick Wroth on the London pleasure gardens. The history of these places has in some cases a strong family resemblance. They usually began as tea gardens, with a bowling green, tea and coffee, hot loaves, and milk "fresh from the cow," as their chief attractions. If the business prospered, other amusements were added, such as music and dancing, with perhaps the exhibition of a giant or a fat woman. Equestrian performances were given in the more important gardens. The manager of one of them kept on the grounds a fine collection of rattlesnakes, one having nineteen rattles and "seven young ones." "Sixteen hundred visitors were present at another one day in August, 1744, to hear honest 'Jo Baker' beat a trevally on his side-drum as he did before the great Duke of Marlborough at the bloody battle of Malplaquet. It was not unusual, moreover, for the owner of a successful tavern to discover on his premises a mineral spring, of which a favorable analysis was easily obtained"—although the spring might be really a bad one. The Spa of Hampstead Wells enjoyed a delightfully pure and invigorating air on the open heath, and had a tavern with coffee rooms, a bowling green, raffling shops, and a chapel, which offered visitors an advantage possessed by no other gardens in London, as a clergyman was always in attendance, and a couple on presenting a license could be married at once on the payment of five shillings. Mr. Wroth suggests that the license was sometimes dispensed with, and the fee, moreover, was remitted if the wedded pair gave a dinner in the gardens.

A Library of Astronomical Photographs.—The appointment of Mrs. M. P. Fleming as curator of astronomical photographs in the Harvard Observatory is noteworthy because hers is the first woman's name to be placed along with the officers in the university catalogue. It is more so as a recognition of Mrs. Fleming's proved abilities in certain lines of astronomical work. The astrophotographic building is not used for the taking of photographs, but as a peculiar kind of library where the plates secured by the astronomers at Cambridge and Arequipa are preserved, arranged, and catalogued, as is done with books. The duties of the curator are like those of a librarian. But instead of books, of which many copies exist, each of the treasures in the photographic collection is unique and can not be duplicated. Prints of them on paper are of little scientific value, because no paper copy can repeat all the minute accuracy of the original negative on glass; and prints are not taken from them for scientific use, but only for illustration. If one is destroyed it can never be replaced; and it is impossible to predict what fact one of them may embody of the greatest importance to the labors of some future astronomer desiring to compare the aspect of his special object of research at his period and ours. Mrs. Fleming's name is frequently mentioned in the reports of the observatory, and she has distinguished herself in several lines of stellar investigation. She has about a dozen women assistants, some of whom are computors of long experience, and some are known by the discoveries they have made.

Forest Planting on the Plains.—Mr. Charles A. Keffer, in a report to the Forestry Division on Experimental Tree Planting in the Plains, defines the forestless region of America as including all the States between the Mississippi River north of the Ozark Mountains and eastern Texas and the Rocky Mountains, together with the plateau west of the Rocky Mountains. The possibilities of forest growth in this vast area are yet to be proved. Roughly speaking, any species that thrive in the adjacent wooded region can be grown in Iowa, the Red River Valley of Minnesota and North Dakota, the Sioux Valley of South Dakota and the eastern counties of Nebraska, and in the more southern States. We know that difficulties of cultivation increase as one goes westward, but we can not say where the western limit of successful tree culture is. We can not even define the limits of successful agriculture in the plains, for with increased facilities for irrigation splendid crops are now produced where only a few years ago it was thought desert conditions would forever prevail. It is admitted that forest planting, as a financial investment, will probably be profitable on the plains only in a limited degree. Favorable sites may enable the profitable raising of fence posts and other specialized tree crops, but the growing of timber on a commercial scale can hardly be expected.

A Siamese Geological Theory.—The east coast of Siam as far south as Champawn is characterized by wide bays, with detached masses of limestone set on steep-sided islands or high-peaked promontories with serrated ridges, the most conspicuous of which is Sam Roi Yawt, or the three hundred peaks. The relations of these various rock masses to one another, Mr. H. Warington Smyth observed, in an address to the Royal Geographical Society, have been long ago lucidly set forth by Siamese geologists, who are unanimously agreed on the subject. "It appears that one Mong Lai and his wife once inhabited the neighborhood (they were giants), and each promised their daughter in marriage, unknown to the other, to a different suitor. At last the day of the nuptials arrived, and Chao Lai and the Lord of Mieang Chin (China) both arrived to claim the bride. When the horrified father found how matters stood—having a regard for the value of a promise, which is not too common in the East—he cut his daughter in half, so that neither suitor should be disappointed. Chao Lai, in the meantime, on finding that he had a rival, committed suicide, and the peak of Chaolai is the remains of his body. The unfortunate bride is to be found in the islands off Sam Roi Yawt, the peaks of which are the remains of the gifts which were to be made to the holy man who was to solemnize the wedding; while Kaw Chang and Kaw King, on the east side of the gulf, are the elephant and buffalo cart in which the presents were brought."

"The Hell of War."—The Cost of a National Crime and The Hell of War and its Penalties are the appropriate names which Edward Atkinson has given to two essays bearing upon the craze for expansion in which the nation has been abruptly plunged. In them an evil which has not yet received due attention, if any, is presented as sure to be inflicted upon us if the policy of militarism is persisted in. "How much increase of taxation," Mr. Atkinson asks, "are you willing to bear, and how many of your neighbors' sons are you ready to sacrifice by fever, malaria, and venereal disease, in order to extend the sovereignty of the United States over the West Indies and the Philippine Islands?" Another question is put to the missionary enthusiasts: "It may be well to ask all who are imbued with this missionary sympathy, How many young men of your own brotherhood are you willing to sacrifice for each convert? How many of your own sons will you expose to sure infection and degeneration in the conduct of your philanthropic purpose? Or will you satisfy your own conscience by consenting to the necessary conscription of other people's sons when it presently becomes impossible to maintain our armed forces in those islands without a draft?" Mr. Atkinson says that his attention has been called to this phase of the evil attendant upon military occupation in the course of his social studies. "The greatest and most unavoidable danger," he writes to the commander in chief of our armies, "to which these forces will be exposed will be neither fevers nor malaria; it will be venereal diseases in their worst and most malignant form."

MINOR PARAGRAPHS.

A new and very ingenious method of space telegraphy is discussed at length in an article by Karl Zickler in the *Elektrotechnische Zeitschrift* It depends on a phenomenon discovered by Hertz in 1887, viz., the influence of certain short wave-length light rays upon electrical discharges. The ultra-violet waves, which are obstructed by glass but transmitted by quartz, are the most effective. The source of light is an arc lamp. The light is passed through a lens of rock crystal to the receiver. The receiver is a glass vessel partially exhausted of air, one end of which consists of a truly parallel plate of rock crystal. In front of the receiver there is a condensing lens of rock crystal, and within the exhausted chamber are the two electrodes, one of which is an inclined disk and the other a small ball. The electrodes are connected with the secondary portion of an induction coil, and when the ultra-violet rays fall upon the inclined disk and are reflected to the ball, a discharge will be produced which may be read either with a telephone or a coherer. The signals are sent by alternately interposing a plate of glass in front of the rays issuing from the transmitter and removing it therefrom. Herr Zickler has made many experiments to verify his conclusions and appears to have demonstrated the feasibility of his idea in practice.

Mr. Dawson Williams has announced in Nature the discovery in many susceptible persons of a periodicity in the effects that follow a sting. The immediate result, he says, is a small flattened wheal, pale and surrounded by a zone of pink injection. This is attended by itching, but both wheal and itching are gone in less than an hour. About twenty-four hours later the part begins to itch again, and in a few minutes a hard, rounded, deep-red papule appears, and is quickly surrounded by an area of œdematous skin. The formication is intense, and in the affected area, while the ordinary sensations of touch are dulled, those of temperature and painful feelings are exaggerated. In two or three hours the itching diminishes and the œdema disappears, leaving a small, red papule, which itches but little. The phenomena recur, with diminished intensity, in the course of another twenty-four hours, and may return in this way, growing fainter all the time, in four or five daily repetitions. After these returns have ceased, a small, indolent papule may persist for weeks or months. This periodicity is not observed in all subjects, but most generally in those who suffer most.

Among the advantages of Linde's liquid-air process, Prof. J. A. Ewing, speaking at the English Society of Arts, claimed its giving a means of separating more or less completely the oxygen of the atmosphere from its associated nitrogen. After describing a process by which a liquid consisting largely of oxygen may be produced, the author said that the most interesting application of the liquid which had hitherto been tried on a commercial scale was to make an explosive by mixing it with carbon. When liquid air, enriched by the evaporation of a large part of the nitrogen, was mixed with powdered charcoal, it formed an explosive comparable in power to dynamite, and which, like dynamite, could be made to go off violently by using a detonator. The chief advantage of the explosive was its cheapness, the cost being only that of liquefying the air. Even the fact that after a short time the mixture ceased to be capable of exploding might be urged as a recommendation, for if a detonator hung fire, there was no danger of the charge going off accidentally some time after the explosion was due, nor was there any risk of its being purloined or used for criminal purposes.

NOTES.

According to the *Tribune de Genève*, twenty new hotels were opened in Switzerland in 1897, and twenty-five were enlarged, adding two thousand beds and making the whole number of beds about ninety thousand. The number of nights' lodgings furnished during the season is estimated at ten million. Supposing each guest to spend twelve francs a day, the total revenue from tourists would amount to one hundred and twenty million francs, or twenty four million dollars. Classifying the guests according to nationality, it is estimated that the Swiss constitute eighteen per cent of the whole, Germans thirty-four per cent, English sixteen per cent, French twelve per cent, Americans eight per cent, and those of other nations twelve per cent.

A list of women astronomers, compiled by Herman S. Davis from Ribiere's *Les Femmes dans la Science*, contains as contemporary workers in the science the names of seventeen American women who have taken part in astronomical computations or are teachers of astronomy, and twelve who are working in the application of photography to astronomy. Of the women in the later list, Miss Ida C. Martin, Miss Dr. Dorothea Klumpke (now in the Paris Observatory), and Mrs. M. P. Fleming have attained distinction for successful original researches.

The object of the Pure Food and Drug Congress, which met in Washington in March, 1898, with Joseph E. Blackburn, of Columbus, Ohio, as president, is declared in its resolutions to be to secure suitable national legislation to prevent the adulteration of food, drink, and drugs, to secure the enforcement of laws, and secure and promote uniformity of State legislation looking to that end; to create and maintain a high public sentiment on these subjects, to sustain public officers enforcing the laws respecting them; and to promote a more general intelligence concerning the injury to health and business interests resulting from food adulteration. In this work all are invited to join. The congress was in session four days, and several important papers were read to it.

The large Atlantic coastal plain beginning with southern New Jersey, Mr. John Gifford affirms, in The Forester, would soon be capable, if protected from reckless devastation, of producing almost limitless quantities of the valuable smooth-bark or short leaf pine. In Northampton and Accomac Counties, Virginia, lying in this plain, the forests are already properly cared for and propagated without the aid of forest laws. This is done by insuring their freedom from fire, which is attended to purely as a matter of present economy. The value of the woods in holding the loose sandy soil and as windbreaks is recognized, and the litter of the pine trees is a precious dressing for the sweet potato fields. This litter, of pine "chats," "needles," or "browse," is carefully raked off every year and spread on the fields, and there is nothing left in which fire can start.

The Lalande prize of the French Academy of Sciences has been conferred upon Prof. S. C. Chandler, of Cambridge, Mass., in recognition of "the splendor, the importance, and the variety" of his astronomical work; the Damoiseau prize upon Dr. George William Hill, of Washington, for his researches in mathematics and astronomy; and the Henry Wilde prize on Dr. Charles A. Schott, of Washington, for his researches in terrestrial magnetism.

Prof. J. Mark Baldwin, of Princeton, author of the books The Development of the Child and the Race, Handbook of Psychology, and The Story of the Mind, has been elected a member of the French Institute of Sociology.

Among the recent deaths of men associated with scientific pursuits we notice those of Charles Michel Brisse, professor at the Lycée Condorcet for twenty-five years, and professor at other French schools, author of papers on the displacement of figures and on the general theory of surfaces, and of other works in mathematics and mathematical physics, and a co-worker on the *Journal de Physique*, in his fifty-sixth year; Prof. H. Alleyn Nicholson, of the University of Aberdeen, author of books on zoölogy and geology; M. F. Gay, of the University of Montpellier, a student of the green algæ, aged forty years; Dr. Dumontpallier, of Paris, author of contributions to the pathology of the nervous system, aged seventy-four years; Lieutenant-Colonel Robert Pringle, of the British Army, author of papers on the hygiene and diseases of India; Pastor Christian Kaurin, of Norway, a student of Scandinavian mosses, aged sixty-six years; T. Carnel, professor of botany and director of the Botanic Garden, Florence; the Rev. Bartholomew Price, author of several elaborate works in mathematics, and secretary of the Oxford University Press, in his eighty-first year; Dr. Constantine Vousakis, professor of physiology in the University of Athens; William Dames, professor of geology and paleontology in the University of Berlin, and subeditor of the *Paläontologische Abhandlungen*, in his fifty-second year; and Dr. Gottlieb Gluge, emeritus professor of physiology and anatomy in the University of Berlin and author of an atlas of pathological anatomy, aged eighty-six years.

MANLY MILES.

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THE STUFF THAT DREAMS ARE MADE OF.

By HAVELOCK ELLIS.

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

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

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

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

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

In typical dreams of a dead friend there is a struggle between that stream of recent memories which represents him as dead and that older stream which represents him as living. These two streams are inevitably caused by the fact of death, which sets up a barrier between them and renders one set of memories incongruous with the other set. In dreams we are not able to arrange our memories chronologically, but we are perpetually reasoning and striving to be logical. Consequently the two conflicting streams of memories break against each other in restless conflict, and sleeping consciousness endeavors to propound some theory which will reconcile them. The most frequent theories are, as I have found, either that the news of the friend's death was altogether false, or that he had been buried alive by mistake, or else that having really died his soul has returned to earth for a brief space. The mental and emotional conflict which such dreams involve renders them very vivid. They make a profound impression even after awakening, and for some sensitive persons are too sacred to speak of. Even so cautious and skeptical a thinker as Renan, when, after the death of his beloved sister Henriette, he dreamed more than once that she had been buried alive, and that he heard her voice calling to him from her grave, had to still his horrible suspicions by the consideration that she had been tended by experienced doctors. On less well-balanced minds, and more especially in primitive stages of

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

civilization, we can scarcely doubt that such dreams, resting as they do on the foundation of consciousness, have had a powerful influence in persuading man that death is but a transient fact, and that the soul is independent of the body. I do not wish to assert that they suffice to originate the belief.*

While dreams are thus often formed by the molding together of more or less congruous images by a feeble but still intelligent sleeping activity, another factor is to be found in the involuntary wavering and perpetually mere meaningless change of dream imagery. Such concentration as is possible during sleep always reveals a shifting, oscillating, uncertain movement of the vision before us. We are, as it were, reading a sign-post in the dusk, or making guesses at the names of the stations as our express train flashes by the painted letters. Any one who has ever been subject to the hypnagogic imagery sometimes seen in the half-waking state, or who has ever taken mescal, knows that it is absolutely impossible to fix an image. It is this factor in dreams which causes them so often to baffle our analysis. In addition to the mere, as it were, mechanical flowing together of images and ideas, and the more or less intelligent molding of them into a whole, there is thus a failure of sleeping attention to fix definitely the final result—a failure which itself may evidently serve to carry on the dream process by suggesting new images and combinations. I dreamed once that I was with a doctor in his surgery, and saw in his hand a note from a patient saying that doctors were fools and did him no good, but he had lately taken some *selvdrolla*, recommended by a friend, and it had done him more good than anything, so please send him some more. I saw the note clearly, not, indeed, being conscious of reading it word by word, but only of its meaning as I looked at it; the one word I actually seemed to see, letter by letter, was the name of the drug, and that changed and fluctuated beneath my vision as I gazed at it, the final impression being *selvdrolla*. The doctor took from a shelf a bottle containing a bright yellow oleaginous fluid, and poured a little out, remarking that it had lately come into favor, especially in uric-acid disorders, but was extremely expensive.

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

I expressed my surprise, having never before heard of it. Then, again to my surprise, he poured rather copiously from the bottle on to a plate of food, saying, in explanation, that it was pleasant to take and not dangerous. This was a vivid morning dream, and on awakening I had no difficulty in detecting the source of its various minor details, especially a note received on the previous evening and containing a dubious figure, the precise nature of which I had used my pocket lens to determine. But what was *selvdrolla*, the most vivid element of the dream? I sought vainly among my recent memories, and had almost renounced the search when I recalled a large bottle of salad oil seen on the supper table the previous evening; not, indeed, resembling the dream bottle, but containing a precisely similar fluid. *Selvdrolla* was evidently a corruption of "salad oil." I select this dream to illustrate the uncertainty of dream consciousness, because it also illustrates at the same time the element of certainty in dream *subconsciousness*. Throughout my dream I remained, consciously, in entire ignorance as to the real nature of *selvdrolla*, yet a latent element in consciousness was all the time presenting it to me in ever-clearer imagery.

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

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

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

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

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

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

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

Dreams of flying have so often been recorded—from the time of St. Jerome, who mentions that he was subject to them—that they may fairly be considered to constitute one of the commonest forms of dreaming. All my life, it seems to me, I have at intervals had such dreams in which I imagined myself rhythmically bounding into the air and supported on the air. These dreams, in my case at all events, are not generally remembered immediately on awakening (seeming to indicate that they depend on a cause which does not usually come into action at the end of sleep), but they leave behind them a vague but profound sense of belief in their reality and reasonableness.* Several writers have attempted to explain this familiar phe-

* Many saints (Saint Ida, of Louvain, for example) claimed the power of rising into the air, and one asks one's self whether this faith may not be based on dream experiences mistranslated by a disordered brain. M. Raffaelli, the eminent French painter, who is subject

nomenon. Gowers considers that a spontaneous contraction of the stapedius muscle of the ear during sleep causes a sensation of falling. Stanley Hall, who has himself from childhood had dreams of flying, boldly argues that we have here "some faint reminiscent atavistic echo from the primeval sea"; and that such dreams are really survivals—psychic vestigial remains—taking us back to the far past, in which man's ancestors needed no feet to swim or float. Such a theory may accord with the profound conviction of reality that accompanies such dreams, though this may be more simply accounted for, even by mere repetition, as with dreams of the dead; but it is rather a hazardous theory, and it seems to me infinitely more probable that such dreams are a misinterpretation of actual internal sensations.

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

to these sleeping experiences of floating on the air, confesses that they are so convincing that he has jumped out of bed on awaking and attempted to repeat the experience. "I need not tell you," he adds, "that I have never been able to succeed."

duced by boots on the foot, or the contact of the ground with the soles; we are at once conscious of movement and conscious that the soles of the feet are in contact only with the air. Thus in normal sleep the conditions may be said to be always favorable for producing dreams of flying or of floating in the air, and any slight thoracic disturbance, even in healthy persons, arising from lungs, heart, or stomach, and serving to bring these conditions to sleeping consciousness, may determine such a dream.

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

I may illustrate such dreams by the following example: A lady dreamed that her husband called her aside and said: "Now, do not scream or make a fuss; I am going to tell you something. I have to kill a man. It is necessary, to put him out of his agony." He then took her into his study and showed her a young man lying on the floor with a wound in his breast, and covered with blood. "But how will you do it?" she asked. "Never mind," he replied, "leave that to me." He took something up and leaned over the man. She turned aside and heard a horrible gurgling sound. Then all was over. "Now," he said, "we must get rid of the body. I want you to send for So-and-so's cart, and tell him I wish to drive it." The cart came. "You must help me to make the body into a parcel," he said to his wife; "give me plenty of brown paper." They made it into a parcel, and with terrible difficulty and effort the wife assisted her husband to get the body down stairs and lift it into the cart. At every stage, however, she presented to him the difficulties of the situation. But he carelessly answered all objections, said he would take the body up to the moor, among the stones, remove the brown paper, and people would think the murdered man had killed himself. He drove off and soon returned with the empty cart. "What's this blood in my cart?" asked the man to whom it belonged, looking inside. "Oh, that's only paint," replied the husband. But the dreamer had all along been full of apprehension lest the deed should be discovered, and the last thing she could recall, before waking in terror, was looking out of the window at a large crowd which surrounded the house with shouts of "Murder!" and threats.

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

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

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

ness to the fact that our intelligence is often but a tool in the hands of our emotions.*

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

When we consider that this dream process, with its perpetual dramatization of our own personality, has been going on as long as man has been man—and probably much longer, for it is evident that animals dream—it is impossible to overestimate its immense influence on human belief. Men's primitive conceptions of religion, of morals, of many of the mightiest phenomena of life, especially the more exceptional phenomena, have certainly been influenced by this constant dream experience. It is the universal primitive explanation of abnormal psychic and even physical phenomena that some other person or spirit is working within the subject of the abnormal experience. Certainly dreaming is not the sole source of such conceptions, but

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

they could scarcely have been found convincing, and possibly could not ever have arisen, among races who were wholly devoid of dream experiences. A large part of all progress in psychological knowledge, and, indeed, a large part of civilization itself, lies in realizing that the apparently objective is really subjective, that the angels and demons and geniuses of all sorts that seemed at first to take possession of the feeble and vacant individuality are themselves but modes of action of marvelously rich and varied personalities. But in our dreams we are brought back into the magic circle of early culture, and we shrink and shudder in the presence of imaginative phantoms that are built up of our own thoughts and emotions, and are really our own flesh.

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

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

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

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

At the same time it is these characteristics which make dreams a fit subject of serious study. It was not until the present century that the psychological importance of the study of insanity was recognized. So recent is the study of savage mind that the workers who have laid its foundation are yet all living. The systematic investigation of children only began yesterday. To-day our dreams begin to seem to us an allied subject of study, inasmuch as they reveal within ourselves a means of entering sympathetically into ideas and emotional attitudes belonging to narrow or ill-adjusted states of consciousness which otherwise we are now unable to experience. And they have this further value, that they show us how many abnormal phenomena—possession, double consciousness, unconscious memory, and so forth—which have often led the ignorant and unwary to many strange conclusions, really have a simple explanation in the healthy normal experience of all of us during sleep. Here, also, it is true that we ourselves and our beliefs are to some extent "such stuff as dreams are made of."

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

THE BEST METHODS OF TAXATION.

By the Late Hon. DAVID A. WELLS.

PART I.

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

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

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

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

Spain from necessity has mortgaged her taxes to the bank, with the task of collecting them.

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

The state monopoly in the manufacture and sale of an article for fiscal purposes holds a place in European countries of high importance, and is met elsewhere under conditions not so favorable to its maintenance. As an example of the latter may be cited the colonial policy of the Dutch in their possessions in the East. After the termination of the trading companies, the Government undertook the entire control of the colonies, and sought to make them a source of revenue. The natives were to be taxed, but, having little of their own to be taxed, and practicing no occupation that could of its own volition become a profitable source of revenue, the state undertook to organize industry, and, by creating an opportunity for employing the labor of the natives, to receive the profits of production for its own uses. The native chiefs were made "masters of industry" and collectors of the revenue; and a certain part of the labor of the natives, one day in every five, was decreed to the state. In order to derive

* Wealth of Nations, vol. i, p. 112 (Rogers's edition).

a profit, this labor must be bestowed in cultivating some product as find a market in international trade. Hence arose the importance of the sugar, coffee, tobacco, and spice crops of these Dutch islands, and for many years a handsome profit to the treasury was obtained from the management and sales of product. With the great fall in prices of sugar and coffee throughout the world, and the narrowing of the market for cane sugar, the Government obtained a less income each year, and has found it of advantage to relax the conditions surrounding cultivation, and to throw the management of the plantations more and more into private hands. To such an extent has this transition been effected that the state can no longer be considered as controlling a monopoly in product or sales, and is content with a revenue from other sources, one that does not even cover the expenses incurred in the colonial system. This experiment differs widely from those industries undertaken with the aid or encouragement of the state to be found in India. It was not with a fiscal object that they were established, and not infrequently the state sacrifices revenue by releasing them from tax burdens they would ordinarily endure. As one of the few remaining instances of the direct participation of a state in the production of products intended for foreign markets, yet undertaken and maintained for fiscal reasons, the history of the Dutch colonies in the East is instructive.

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

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

* Bastable. Public Finance, p. 181.

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

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

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

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

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

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

From this weight of tradition and precedent the United States has been almost entirely free, and it was possible to construct out of small beginnings systems of Federal and State taxation at least reasonable and consistent, producing an increasing revenue with the rapid development of wealth and the larger number of taxable objects; and so elastic as to adapt themselves to such changes as are inevitable in any progressive movement of commerce or industry. That no such system has resulted after a century of national life, and an even longer term of local (colonial and State) activities, these papers have tended to show. That the time is at hand when the problem of a thorough reform of both State and Federal taxation must be met, current facts prove beyond any doubt. If I have aided in a proper comprehension of these problems, and, by collecting certain experiences in taxation among other peoples and in different stages of civilization, contributed toward a proper solution, the end of this work will have been attained. It is not possible to introduce a complete change of policy at once; it is not only feasible but necessary to indicate the direction this change should take, and the ends to be secured in making them. And first as to Federal taxation:

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

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

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

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

The second objection to the increasing complexity of the tariff laws is to be found in the petty annoyances imposed upon importers and others in enforcing the not always consistent provisions of the law. These vexations are made all the more telling by the fact that the administration of the law is apt to be in the hands of those who are openly hostile to foreign importations, and therefore regard the importer in an unfriendly spirit. The power given to the customs agents is enormous, and it is not remarkable that it is abused. The demand for samples, the appraisement of articles, the classification of new or compound commodities, all offer room for controversy, which is not always decided by an appeal to the courts of justice. In special instances, where a section of the law has been framed in behalf of a special interest, the attempt to enforce it becomes petty tyranny of the most intolerable kind.

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

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

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

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

MENTAL DEFECTIVES AND THE SOCIAL WELFARE.

By MARTIN W. BARR, M. D.,

CHIEF PHYSICIAN, PENNSYLVANIA TRAINING SCHOOL FOR FEEBLE-MINDED CHILDREN, ELWYN, PA.

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

True, science has contributed to numbers by revealing as mental defectives the many "misunderstood," "the backward," "the feebly

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

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

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

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

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

Excitable Idiot. Practically unimprovable.

Apathetic Idiot. Practically unimprovable.

Idio-Imbecile. But slight hope of improvement.

readily be seen, as also how entirely incompatible with union must be work further apart in reality than is the training of an imbecile and a normal child.

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

The character of attendants is of the first importance, as these are they who live with the children; it should combine that firmness, tenderness, and balance that constitute an even temperament, capable of recognizing and meeting an occasion without loss of self-control. The duties involve not only the care of the idiots, but the training and direction of idio-imbeciles as aids, and this dealing with natures often wholly animal, requires a certain refinement and dignity of character—at least an entire absence of coarseness—while a knowledge of the simpler manual arts, and if possible of drawing and music, will do much to soften and brighten these darkened natures. As these qualities are valuable as well as rare, the remuneration should be in proportion; certainly sufficient to induce permanency and to compensate for such isolation. A life of constant wear and tear demands also regular periods of rest, and the corps therefore should be sufficiently large to give relief hours daily as well as vacations.

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

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

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

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

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

High-grade Imbecile.

High grade Imbecile.
Very improvable—can read, write, draw, etc.

Low-grade Imbecile. Only slightly improvable.

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

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

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

Moral Imbecile of High Grade.

Moral Imbecile of Middle Grade.

Moral Imbecile, Low Grade.

with some practical work of house, garden, or farm, which forms part of the daily routine, are all that school life can do for him.

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

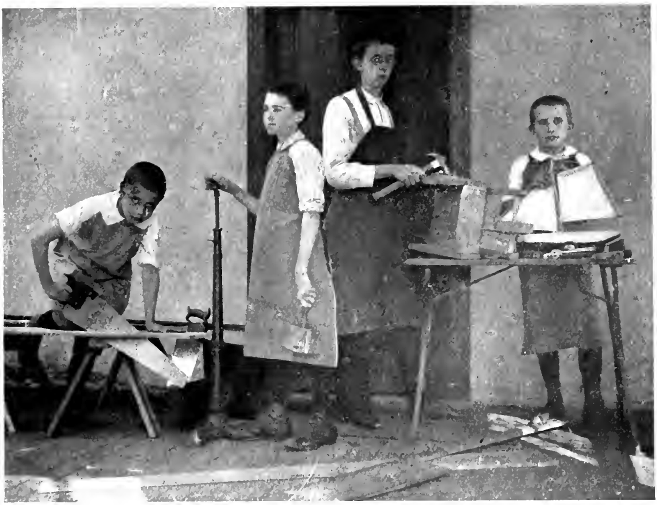
When we consider that the training of a high-grade imbecile takes four times the period commonly allotted to a normal child, some idea of the vital energy expended on the training of the lower grades may be found in the following example:

I find in our museum of educational work a little ball which I am inclined to regard the most valuable thing in the whole collection. The boy who made it was a low-grade imbecile. His hand against every man, he fancied every man's against him. Always under strict custodial care, that he might harm neither himself nor others, he would vent his spleen in tearing his clothing. His teacher, a woman of rare patience and devotedness, sat beside him one day, tearing strips of old linen and laying them in order. "See, Willie, let us make some pretty strips and lay them so." His wonder grew apace at seeing her doing what he had been reproved for doing; at once he responded, and a new bond of sympathy was established between them. She was playing his game—the only one, poor little lad, that he was capable of—and he joined in.

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

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

The imbecile of middle grade receives that fuller presentation of work suited to fuller capacity. Some time is devoted to the three "Rs," as it is found that attention may be aroused and concentrated in the phonetic drills, more especially if associated with pictures, and the drawing of the objects named free-hand; thus eye, ear, and hand



HIGH-GRADE IMBECILES (FEEBLY GIFTED) AT SLOYD WORK.

are encouraged to work simultaneously. Those who accomplish finally the reading of short simple stories not only enjoy evenings in the library, but may be enabled to glean suggestions for the various handicrafts for which they are being trained. This effort at quick observation and original thinking is further carried forward in the ambidextrous movements of free-hand drawing, designing, and sketching from life—finding ready and practical application in the daily use of tools. The value of the rule and the try-square is tested in the manufacture of the various useful articles in both paper and wood included under the head of sloyd, and "a boy can not learn to take a straight shaving off a plank," says Ruskin, "or to drive a fine curve without faltering, or to lay a brick level in the mortar, without learning a multitude of other matters which life of man could never teach him."

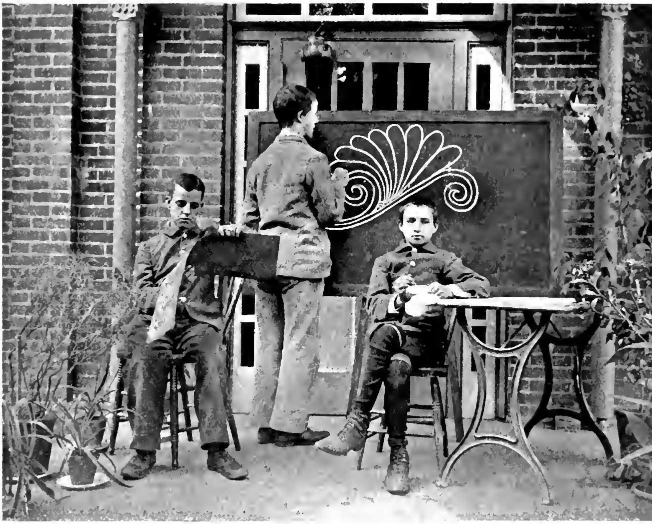
Equally useful to the girl in the workroom as to the boy in the shop is this training of a ready eye, this quick intuition of balance and proportion, this practice of obedience of hand and arm to brain, until it becomes automatic. To both, therefore, the value of such preparation will be incalculable.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

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

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

The separation of backward children in the schools and the placing of them in special classes for special training is the first step in the right direction. Here, after sufficient time for observation and diagnosing by teacher and physician, the defectives so adjudged will naturally drift to the training schools for the feeble-minded; these.

if relieved of the odium as well as the care of their helpless population, will then be encouraged to arrange for this brighter class of defectives industries which will provide not only for development and happiness, but will largely aid in maintenance. The recognition of



Middle-grade Imbeciles.

the necessity for this weeding out of the schools, having place first on the Continent, next in England, and later in our own country, marks an era in the national as well as in the special schools. Both will be benefited largely, and formal expression of this, found in the addition to our National Educational Association of a department representing the training of all classes of defectives, is one of the most encouraging signs of the times.

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

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

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

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

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

"The State of Connecticut is about to try a curious experiment in social legislation, having passed a law forbidding any man or woman, imbecile or feeble-minded, to marry under forty-five years of age, the penalty being imprisonment for not less than three years; and persons aiding and abetting are also liable. The hope of the legislature is to keep down degenerate families."

That this experiment is wise and justifiable who can doubt?

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

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

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

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

THE WHEAT PROBLEM AGAIN.

By EDWARD ATKINSON.

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

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

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

The Italics are my own.

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

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

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

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

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

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

A good beginning has been made by the authorities of many States, yet more by the body of well-trained men in charge of the Agricultural Experiment Station, in whose support too much can not be said. To them I appealed when trying to get an adequate conception of our potential in wheat.

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

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

Witness the blunders of the past:

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

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

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

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

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

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

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

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

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

1897 and 1930 compared.—Data of 1897.

	Products.	Average per acre.	Area required.
Maize	1,902,967,933 bushels.	23.8 bushels.	125,150 square miles.
Wheat	530,149,168 "	13.4 "	61,660 " "
Oats	698,767,809 "	27.2 "	40,200 " "
Hay	60,664,770 tons.	1.43 "	66,290 " "
Total in square miles			293,300 square miles.

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

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

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

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

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

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

Prospective Use of Land in the Year 1930 on Present Crop Average.

Arable land assumed to be 2,000,000 square miles in the outer lines of the diagram.

Oats, 70,800 sq. miles.	Wheat, 81,600 sq. miles.	Hay, 109,400 sq. miles.	Miscellaneous. Roots, cotton, tobacco, etc., 168,600 sq. m. Excessive.	Maize, Indian corn, 226,600 sq. miles.	Wheat for export, 143,000 sq. miles.

Arable land unassigned .... 1,200,000 square miles.
Deduct for cities, towns, parks, and reserves of all kinds 200,000 " "

Reserve for future use .... 1,000,000 " "
Forest, mountain, arid, etc., not counted, about 1,000,000 square miles, not included in these lines or squares.

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

If the facts should be in 1930 consistent with Mr. Hyde's "speculation" it would therefore appear that our ability to meet the domestic demand of 1930 with proportionate export of cattle, provisions, and dairy products, and to set apart a little patch of land for the export of 1,226,000,000 bushels of wheat raised at the rate of only

13.4 bushels per acre from 143,000 square miles of land will be met by the cultivation of not exceeding 700,000 square miles out of 2,000,000 available.

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

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

Boston, Mass., *October 5, 1898.*

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

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

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

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

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

Answer .... square miles.

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

Answer .... square miles.

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

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....

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

Answer .... square miles.

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

....

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

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Your assistance in this matter will be gratefully received.

Respectfully submitted,

EDWARD ATKINSON.

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

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

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

The foregoing States produced a little over one third of the wheat crop of 1897. They comprise a little over one third the area of the land of the United States, excluding Alaska.

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

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

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

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

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

In these accounts of this great farm are included all charges of every name and nature except what might be called the rent of land: the labor, the harvesting and thrashing, the general expense including the foreman and all other charges; the office expenses, the taxes, Again, let it be remembered that Texas will produce a cotton crop, marketed in 1898–'99, above the average of the five ante-war crops of the whole country, and nearly equal to the largest crop ever grown in the United States before the war. Texas could not only produce the present entire cotton crop of the United States but of the world, on but a small part of her land which is well suited to cotton. When these facts are considered, perhaps the potential of that great State in wheat and other grain, in cattle and in sheep, as well as in cotton, may begin to be comprehended.

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

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

Finally, if I shall have drawn attention to the very effective work which is being done in the agricultural experiment stations by men of first-rate ability, I shall have drawn attention to a great fact. This work has already led to a complete revolution from the

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the insurance, and, when summer fallow is introduced, the cost of the summer fallow. Suffice it that these figures for 1898—a year of high charge for seed and one which yielded a fraction over the average in product—prove conclusively an average of all charges of less than five dollars an acre for the cost of the product. In different years under these conditions the cost of the wheat varies from a little over twenty cents to approximately thirty-five cents per bushel. The cost of oats, which are cultivated with the wheat mainly for use on the farms, ranges from ten to fifteen cents per bushel.

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

old practice of maltreating land, and to the renovation of soils that had been partially exhausted. Governor Henry A. Wise, of Virginia, long since condemned the old methods of Southern agriculture by telling his hearers, "The niggers skinned the land and the white men skinned the niggers." We are changing all that by new and progressive methods. I hope that in this recognition of the work of the experiment stations I shall have made some return for the attention which has been given to my inquiry by so many of my correspondents that the space assigned me forbids a list of my authorities being given by name.

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

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

In my efforts to discover the rule of progress in the arts and occupations of the people of this country, it has become plain that in ratio to the application of science and invention to every art the quantity of product is increased, the number of workmen is relatively diminished, the price of the product tends to diminish, while the wages or earnings of those who do the work are augmented. I have investigated many branches of industry, and find evidence conclusive to my own mind that such is the law of industrial development. This rule is subject to temporary variations under the restriction of statutes. In my own judgment, the so-called protective principle or policy of interference with commerce by imposing fines on foreign imports has retarded the progress of the specially protected arts, and has in some measure obstructed the diversity of manufactures; but the opposite policy of absolutely free trade in our domestic traffic over a greater area and among a much larger number of people than have elsewhere secured their own liberty has been so much more potent in its progressive influence as to have lessened the evils of the restrictions on foreign trade.

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

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

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

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

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

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

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

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

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

THE COMING OF THE CATBIRD.

By SPENCER TROTTER.

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

With this forerunner of the year come the harbingers of the bird migration. With the rise of the temperature to sixty or over, a well-marked bird wave from the south spreads over the Delaware Valley. On this balmy, springlike day we hear for the first time since November the croaking of grackles as a loose flock wings overhead or scatters among the tree tops. A few robins may show themselves, and the mellow piping of bluebirds lends its sweet influence to the charm of such a day. There is a sense of uncertain whereabouts in the bluebird's note, a sort of hazy, in-the-air feeling that suggests sky space. It does not seem to have the tangible element by which we can locate the bird as in the voices of the robin and the song sparrow. It is on such a day as this that song sparrows are first heard—

cheery ditties from the weather-beaten fences and the bare, brown tangle of brier patches. The day may close lurid with the frayed streamers of lofty cirrus clouds streaking across the sky—the vaporous overflow of a coming storm—or a week of the same bright weather may continue with the wind all the while blowing softly out of the south, but sooner or later the inevitable winter storm must close this foretaste of the spring.

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

After the 1st of April the tide of migration sets in with force, and the earlier waves bring several species of summer birds—those that come to build and breed in our woods—that rarely if ever make their appearance before this time. It is an interesting fact that none of the migrants that make their first appearance in April are ever found in the Delaware Valley during the winter, though several, if not all, of the species that come on the March waves are occasionally met with in the winter months. It appears, further, that the winter quarters of certain birds which are summer residents with us and some that are transient, passing on to more northern breeding grounds, lie not so very far to the south. If the last of March has been marked by warm weather lapping over into the first days of April, then one may expect soon to hear the familiar notes of the chipping sparrow from the swelling branches of garden shrubbery and the trees about the lawn, and a brown thrasher is sure to be heard volubly proclaiming his arrival from some near-by tree top. Among the budding sprigs of thickets the elusive chewink breaks into occasional fragments of song, and from the red-blossomed maples and the jungle of pussy willows and alders that fringe the meadow brook the metallic creaking notes of the red-winged blackbirds sound not unpleasingly. This jargon of the red-wing has a true vernal ring about it, suggesting the fresh green of oozy bogs and the loosening up of sap.

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

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

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

Some ten or more years ago several enthusiastic ornithologists living in the neighborhood of Philadelphia began keeping records of the times of arrival of the different species of birds, and at the same time noted the conditions of temperature in relation to the abundance of individuals. After several years of these observations they were able to see clearly that these bird waves were directly related to the waves of rising temperature marking the advent of warm spells of weather. One of the most significant facts deduced from these observations was the remarkable regularity in the first appearance of certain species. For example, the Baltimore oriole in eight years of observation never arrived before the 1st of May, and only twice later than the 4th—viz., once on the fifth and once on the 7th. The list on the opposite page shows the date of first arrivals extending over a period of eight years, from 1885 to 1892.*

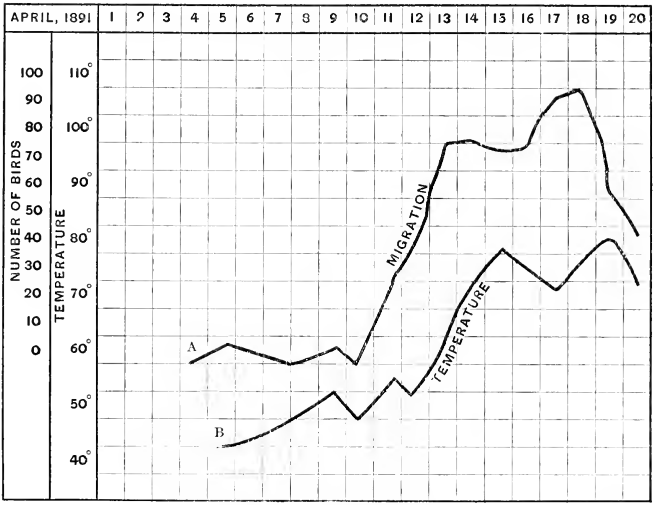
Another fact of great interest which bears on the south-to-north movement of migrating birds, and which these observations very clearly brought out, was the earlier appearance of individuals of various species at points nearer the river, the first arrival of the same species at points back from the river being, in many instances, several days later. The first report of the arrival of a given species usually came from a low, marshy tract of land immediately bordering the western shore of the Delaware. The second report came from a locality several miles back of the eastern shore of the river, but situated in the low plain of the river valley and within tide-water limits. The third report came from a place some miles back from the river on the uplands, but near the head of a stream emptying into the

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

Delaware from the west. The last two places to report arrivals were situated farther up the river and some distance back from it. All this confirms the general idea that in migrating most, if not all, of the various land birds follow river valleys and invade the upland districts, lying back from either side, by way of the smaller tributaries.

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

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



A, migration; B, temperature.

The advent of spring is marked by the northward progression of the isotherm of 42.8° F., which is the initial temperature required to awaken the dormant reproductive and germinating activities in animals and plants. With the gradual invasion of the United States, from the south northward, by temperatures above this, there passes over the different regions the ever-old but ever-new panorama of the spring with its opening blossoms, its unfolding green, and its waves of migrating birds. The restlessness produced by the periodic development of the reproductive function under the stimulus of increased temperature causes the highly organized bird life to spread out from its winter quarters, wherever those may be, and follow the zone of new green that steadily widens northward with its increase of food supply in the form of myriads of insects. The comparative regularity in the recurrence of this phenomenon year after year is attested by the observations just noted. Each species has a certain, definite physiological relation to temperature, and its migratory movement toward the breeding ground is determined by the movement of the

* Stone. The Birds of Eastern Pennsylvania and New Jersey.

isotherm of this temperature. Just as warm a spell of weather may occur in early April as in the first week of May, but it does not represent the permanent summer rise; and the majority of the warblers, the catbird, the tanager, the rose-breasted grosbeak, the two species of oriole, the vireos, and the kingbird, are rarely if ever seen in abundance in the Delaware Valley before the 1st of May. The migratory movement of such species is as regular as any other periodic phenomenon in Nature.

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

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

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

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

GUESSING, AS INFLUENCED BY NUMBER PREFERENCES.

By F. B. DRESSLAR.

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

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

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

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

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

After the very arduous and tedious task of collating and classifying all the guesses for men and women separately had been done, the following facts appeared:

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

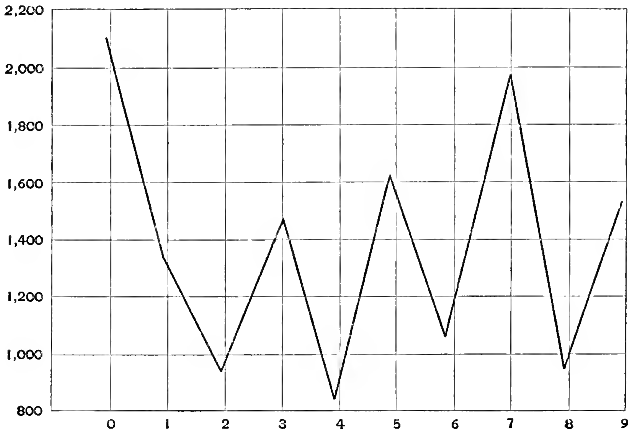
A tabulation of the figures used in tens' place shows, save in the case of 2 and 3, where 2 is used oftener than 3, the same curious preferences, but in a much less marked degree. To go into detail, 850 chose 9 for tens' place, while 559 took 8; 907 used 7, while only 637 selected 6; 748 took 5, while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

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

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

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

It will be noticed that of the digits preferred, 7 surpasses any of the others. Not only, then, do we tend to select an odd number for units' place when the guess ranges between one and a thousand, but of these digits 7 is much preferred. In connection with this fact one immediately recalls all he has heard about 7 as a sacred number, and its professed significance in the so-called "occult sciences." I think one is warranted in saying from an introspective point of view



CHOICE OF DIGITS IN TENS' AND UNITS' PLACES (MEN AND WOMEN).

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

that there is a shadow of superstition present in all attempts at pure guessing. There appears to be some unexpressed feeling of lucky numbers or some mental easement when one unreasoned position is taken rather than any other.

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

The Greeks considered the even numbers as representative of the feminine principle, and as belonging and applying to things terrestrial. To them the odd numbers were endowed with a masculine virtue, which in time was strengthened into supernatural and celestial qualities. The same belief was prevalent among the Chinese. With them even numbers were connected with earthly things, partaking of the feminine principle of Yang. Odd numbers were looked upon as proceeding out of the divine and endued with the masculine principle. Thirty was called the number of earth, because it was made up by the addition of the even numbers 2, 4, 6, 8, and 10. On the other hand, 25, the sum of the five odd numbers 1, 3, 5, 7, and 9, was called the number of heaven.

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

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

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

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

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

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

Another thing is noticeable in these guesses. The consciousness of number beyond 1,000 falls off very rapidly. The difference in the values of 1,000 and 1,500 seems to have had less weight with the guessers than a difference of 50 had at any place below 1,000. And so, in a way, 1,000 seems to mark the limit of any sort of definite mental measurement. This fact is more and more emphasized as the numbers representing the guesses increase until one can see there exists absolutely no conception of the value of numbers. For example, many guessed 1,000,000, while several guessed more than

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

10,000,000. Guessing means, with many people, no attempt at any sort of reasonable measurement, but rather an attempt to express their guess in such a way as to afford them the greatest amount of mental relief. And this relief can not be wholly accomplished without satisfying number preferences. Therefore, guessing is likely to exhibit, in a greater or less degree, some habitual lines of preference subject to predetermination. It may be that much practical advantage has been taken of these facts in games of chance where number selections play an important part.

CONCERNING WEASELS.

By WILLIAM E. CRAM.

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

denly I found myself staring at the smooth greenish-gray root of the maple with no weasel in sight. Judging from my own experience, I should say that this is the usual termination of any chance observations of either weasels or minks.

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

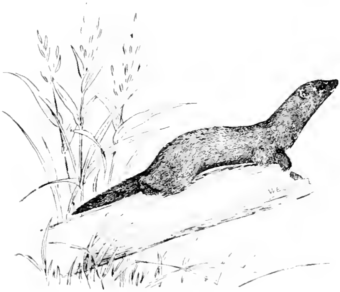
In all probability this vanishing is accomplished by extreme rapidity of motion, but if this is the case then the creature succeeds in doing something utterly impossible to any other warm-blooded animal of its size. Mice, squirrels, and some of the smaller birds are all of them swift enough at times, but except in the case of the humming bird none of them, I believe, succeed in accomplishing the result achieved by the weasels. The humming bird, in spite of its small size, leaves us a pretty definite impression of the direction it has taken when it darts away; but when a mink, half a yard in length and weighing several pounds, stands motionless before one with his dark coat conspicuous against almost any background, and the next instant is gone without a rustle or the tremor of a blade of grass, it leaves one with an impression of witchcraft difficult to dispel, and best appreciated when one sees it for one's self. Nor is the everyday life of the weasel quiet or commonplace; his one object in life apparently is to kill, first to appease his hunger, then to satisfy his thirst for warm blood, and after that for the mere joy of killing.

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

The common weasel or ermine, which is the only kind I have seen hereabouts, would seem to have everything on its side in the struggle for existence, and when one happens to be killed by some larger inhabitant of the woods it must be due entirely to its own carelessness. Nevertheless, they do occasionally fall victims to owls and foxes, and I once shot a red-tailed hawk that was in the act of devouring one. Still, these casualties among weasels are probably few and far between. Fortunately, however, they never increase to any great extent. Occasionally in the winter the snow for miles will be covered with their tracks all made in a single night, and then for weeks not a track is to be seen; but usually they prefer to hunt alone, each having its beat a mile or more in length, over which it travels back and forth throughout the season, passing any given point at intervals of two or three days. This habit of keeping to the same route instead of wandering at random about the woods is characteristic of the family, the length of the route depending to a certain extent on the size of the animal. The mink is usually about a week in going his rounds, and may cover a dozen miles in that time, while the otter is generally gone a fortnight or three weeks. When it is possible the ermine prefers to follow the course of old tumble-down stone walls, and lays its course accordingly. In favorable districts he is able to keep to these for miles together, squeezing into the smallest crevices in pursuit of mice or chipmunks. All the weasels travel in a similar manner—that is, by a series of leaps or bounds in such a way that the hind feet strike exactly in the prints made by the fore paws, so that the tracks left in the snow are peculiar and bear a strong family resemblance. On soft snow the slender body of the ermine leaves its imprint extending from one pair of footprints to the next, and as these are from four to six feet apart, or even more, the impression left in the snow is like the track of some extremely long and slender serpent with pairs of short legs at intervals along its body. I have said that the ermine is the only true weasel I have found in this vicinity, but this is not strictly true, at least I hope not. One winter I repeatedly noticed the tracks of an exceedingly large weasel—so very large, in fact, that I was almost forced to believe them to be those of a mink. The impression of its body in the snow was quite as large as that made by a small mink, but the footprints themselves were smaller, and the creature appeared to avoid the water in a manner quite at variance with the well-known habits of its more amphibious cousin, while, unlike the common weasel, it never followed stone walls or fences. I put my entire mind to the capture of the little beast, and set dozens of traps, but it was well along in the month of March before I succeeded. It proved to be a typical specimen of the Western long-tailed weasel, though I can find no account of any other having been taken east of the Mississippi. Its entire length was about eighteen inches; the tail, which was a little over six, gave the effect at first glance of being tipped with gray instead

of black, but a closer inspection showed that the black hairs were confined to the very extremity and were partly concealed by the overlying white ones; the rest of the fur was white, with a slight reddish tinge, and much longer and coarser than that of an ermine. Since then I have occasionally seen similar tracks, but have not succeeded in capturing a second specimen. In all probability the least weasel is also to be found here if one has the patience to search carefully enough; none, however, have come under my observation as yet. All the small weasels that I have seen have proved on close inspection to be young ermines with thickly furred black-tipped tails; in the least weasel the tail is thinly covered with

short hair and without any black whatever. Late in the autumn or early in the winter the ermine changes from reddish-brown to white, sometimes slightly washed with greenish-yellow or cream color, and again as brilliantly white as anything in Nature or art; the end of the tail, however, remains intensely black, and at first thought might be supposed to make the animal conspicuous on the white background of snow, but in reality has just the opposite effect. Place an ermine on new-fallen snow in such a way that it casts no shadow, and you will find that the black point holds your eye in spite of yourself, and that at a little distance it is quite impossible to follow the outline of the weasel itself. Cover the tail with snow, and you can begin to make out the position of the rest of the animal, but as long as the tip of the tail is in sight you see that and that only. The ptarmigan and northern hare also retain some spot or point of dark color when they take on their winter dress, and these dark points undoubtedly serve the same purpose as in the case of the ermine.



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

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

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

CARE OF THE THROAT AND EAR.

By W. SCHEPPEGRELL, A. M., M. D.,
PRESIDENT WESTERN OPHTHALMOLOGIC AND OTO-LARYNGOLOGIC ASSOCIATION, NEW ORLEANS, LA.

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

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

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

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

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

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

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

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

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

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

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

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

In addition to these means there are certain injurious conditions that it would be well to avoid. One almost universally present in large cities is that of dust. The constant inhalation of the small particles of sand and of organic impurities of which dust is composed has an irritating effect on the delicate lining of the nose and throat, which may develop a chronic inflammation, resulting in injury to both the throat and ear. This evil, however, can be prevented by the artificial watering of our streets.

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

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

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

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

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

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

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

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

While we have at the present time no means of inoculation that will permanently protect against infection from diphtheria, still it is not of such an infectious character as smallpox, as the cases are usually limited to children, and its spread may therefore be more easily prevented. Not only should children who have had diphtheria be prevented from returning to school until infection is no longer possible, but other children of the same household should also be kept at home. A few years ago a certain school in this city was rarely without a case of diphtheria among its pupils for many months. I am convinced that had the principal of the school or the parents insisted upon the other children of the infected household remaining at home, the spread in this direction would have been arrested and much suffering avoided.

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

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

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

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

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

The germ of tuberculosis is the seed, and the predisposed person the soil, and it requires a combination of both to develop the disease. To illustrate the necessity of suitable conditions for the development of plants—for it is now almost universally admitted that the germ of tuberculosis is a micro-organism which belongs to the vegetable kingdom—I remember some years ago, while in North Europe, seeing in a hothouse a plant which is here commonly known as the " four o'clock." The gardener in charge of the conservatory considered it a remarkable plant, but difficult to propagate, and stated that it was absolutely impossible to raise it out of doors. In this part of the world, however, we know that this plant grows so easily that once established in a garden it is difficult to keep it within limits. In both of the cases we have the same seed, the difference being only in the soil and the conditions favorable for its development. The absence of either the seed or the soil will absolutely prevent tuberculosis, and if the laws of hygiene are properly carried out, both in destroying the seed and in preventing the formation of a suitable soil, favorable effects will soon be shown.

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

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

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

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

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

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

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

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

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

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

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

THE PHYSICAL GEOGRAPHY OF THE WEST INDIES.

By F. L. OSWALD.

I.—THE FAUNA OF THE ANTILLES: MAMMALS.

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

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

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

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

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

The Old-World tribes of our tree-climbing relatives are so totally different from those of the American tropics that Humboldt's traveling companion, Bonplant, renounced the theory of a unitary center of creation (or evolution), and maintained that South America must have made a separate though unsuccessful attempt to rise from lemurs to manlike apes and men. Of such as they are, Brazil alone has forty-eight species of monkeys, and Venezuela at least thirty.

How shall we account for the fact that not one of the large West Indian islands betrays a vestige of an effort in the same direction?

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

The first Spanish explorers of the Antilles were, in fact, so amazed at the apparently complete absence of quadrupeds that their only explanation was a conjecture that the beasts of the forest must have been exterminated by order of some native potentate, perhaps the great Kubla Khan, whose possessions they supposed to extend *eastward* from Lake Aral to the Atlantic. The chronicle of Diego Columbus says positively that San Domingo and San Juan Bautista (Porto Rico) were void of mammals, but afterward modifies that statement by mentioning a species of rodent, the *hutia*, or bush rat, that annoyed the colonists of Fort Isabel, and caused them to make an appropriation for importing a cargo of cats.

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

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

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

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

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

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

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

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

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

Fish otters have been caught in the lagoons of Puerto Principe (central Cuba) and near Cape Tiburon, on the south coast of San Domingo, the traveler Gerstaecker saw a kind of "bushy-tailed dormouse, too small to be called a squirrel."

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

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

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

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

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

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

Millions of runaway hogs roam the coast swamps of all the larger

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

[*To be continued.*]

IRON IN THE LIVING BODY.

By M. A. DASTRE.

IRON occurs, in small and almost infinitesimal proportions, in numerous organic structures, in which its presence may usually be detected by the high color it imparts; and in the animal tissues is an important ingredient, though far from being a large one. It is essential, however, that the animal tissues, and particularly the liquids that circulate through them, should be of nearly even weight, else the equilibrium of the body would be too easily disturbed, and disaster arising therefrom would be always imminent. Hence the iron is always found combined and associated with a large accompaniment of other lighter elements which, reducing or neutralizing its superior specific gravity, hold it up and keep it afloat. Thus the molecule of the red matter of the blood contains, for each atom of iron, 712 atoms of carbon, 1,130 of hydrogen, 214 of nitrogen, 245 of oxygen, and 2 of sulphur, or 2,303 atoms in all. Existing in compounds of so complex composition, iron can be present only in very small proportions to the whole. Though an essential element, there is comparatively but little of it. The whole body of man does not contain more than one part in twenty thousand of it. The blood contains only five ten-thousandths; and an organ is rich in it if, like the liver, it contains one and a half ten-thousandths. When, then, we seek to represent to ourselves the changes undergone by organic iron, we shall have to modify materially the ideas we have formed respecting the largeness and the littleness of units of measure and as to the meaning of the words abundant and rare. We must get rid of the notion that a thousandth or even a ten-thousandth is a proportion that may be neglected. The humble ten-thousandth, which is usually supposed not to be of much consequence, becomes here a matter of value. Chemists working with iron in its ordinary compounds may consider that they are doing fairly well if they do not lose sight of more than a thousandth of it; but such looseness would be fatal in a biological investigation, where accuracy is necessary down to the infinitesimal fraction. The balances of the biologists must weigh the thousandth of a milligramme, as their microscopes measure the thousandth of a millimetre.

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

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

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

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

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

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

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

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

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

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

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

Compounds of iron are so abundant in the ground and the water that we need not be surprised when we find them in various parts of plants, and particularly in the green parts. Their habitual presence does not, however, authorize the conclusion that this metal is necessary to the support and development of vegetable life. Some substances, evidently indifferent, foreign, and even injurious, if they exist abundantly in a soil, may be drawn into roots through the movement of the sap, and fix themselves in various organs. This occurs with copper in certain exceptional circumstances when the soil is saturated with its compounds, and if such a condition should be found to be repeated over a large extent of country, we might be led, by analysis alone of its vegetable productions, to the false conclusion that copper was an essential or even necessary constituent of them. But the value of the part performed by an element can not be determined by analysis alone. Direct proofs are necessary for that, methodical and comparative experiments in cultivation in mediums artificially deprived or furnished with the element the importance of which we wish to estimate. This has been done for combinations of iron, and the utility of that metal, especially to the higher plants, has been made thereby to appear.

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

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

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

THE MALAY LANGUAGE.

By R. CLYDE FORD,
PROFESSOR OF GERMAN LANGUAGE AND LITERATURE, ALBION COLLEGE.

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

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

The Malays are not barbarians, and their language by its grace and adaptability has shown its right to be. To-day it is the mother tongue of more than forty millions of people, and the *lingua franca* of Chinamen, Hindus, European, and natives. It is spoken from Madagascar to the distant islands of the Pacific, and from the Philippines to Australia. With it one can barter in Celebes and sell in Java; converse with a sultan in Sumatra or a Spaniard in Manila. Moreover, it is soft and melodious, rich in expression, poetical in idiom, and simple in structure—a language almost without grammar and yet of immense vocabulary, with subtle distinctions and fine gradations of thought and meaning; a language that sounds in one's ears long after *Tanah Malayu* and the coral islands and the jungle strand have sunk into hazy recollection, just as they once dropped out of sight behind one's departing ship.

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

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

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

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

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

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

As a language Malay is easily learned and has much to repay for so doing. It is full of wonders and surprises—among other things is the natural home of euphemism, where a spade is called anything but a spade. For instance, to die is beautifully expressed in Malay as a return to the mercy of Allah. The language is decidedly rich in poetical expression and imagery. A neighbor is one whom you permit to ascend the ladder of your cottage, and your friend is a sharer of your joys and sorrows. Interest is the flower of money, a spring is an eye of water, the sun the eye of day, and a policeman all eyes. A walk is a stroll to eat the wind, a man drunk is one who rides a green horse, and a coward a duck without spurs. A flatterer is one who has sugar cane on his lips, a sharper is a man of brains, a fool a brain-lacker.

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

Will the crocodile respect the carcass?

Follow your heart, death; follow your feelings, destruction.

You find grasshoppers where you find a field.

Earth does not become grain.

Don't grind pepper for a bird on the wing.

The flower comes, age comes.

When the father is spotted, the son is spotted.

The plant sprouts before it climbs.

When he can't wring the ear, he pulls the horn.

The creel says the basket is poorly made.

Ask from one who has,
Make vows at a shrine,
Sulk with him who loves you.

When the house is done the chisel finds fault.

As the crow goes back to his nest (no richer, no poorer).

Whoever eats chilies burns his mouth.

Because of the mouth the body comes to harm.

If you are at the river's mouth at nightfall, what's the use of talking of return?

A broken thread may be mended, but charcoal never.

The pea forgets its pod.

As water rolls from a *kladi* leaf.

A shipwrecked vessel may float again, a heart once broken is broken forever.

It is a project, and the result with God.

He carries a torch in daylight.

A slave who does well is never praised; if he does badly, never forgiven.

It rains gold afar, but stone at home.

What if you sit on a cushion of gold with an uneasy mind!

When money leaves, your friend goes.

If you dip your hand into the fish tub, go to the bottom.

Whoever digs a hole falls into it himself.

If your legs are long, have your blanket long.

Like a frog under a cocoanut shell, he thinks he sees the sky.

If you can't get rattan, bind with roots.

The plantain does not bear twice.

He sits like a cat, but leaps like a tiger.

The tortoise lays a thousand eggs and tells no one; the hen lays a single egg and tells all the world.

Those will die of thirst who empty the jar when it thunders in a dry time.

Handsome as a princess, poisonous as a snake.

Small as an ant, wise as a mouse-deer.

LIFE ON A SOUTH SEA WHALER.*

By FRANK T. BULLEN.

CACHALOTS, or sperm whales, must have been captured on the coasts of Europe in a desultory way from a very early date, by the incidental allusions to the prime products spermaceti and ambergris which are found in so many ancient writers. Shakespeare's reference—"The sovereign'st thing on earth was parmaceti for an inward bruise"—will be familiar to most people, as well as Milton's mention of the delicacies at Satan's feast—"Grisamber steamed"—not to carry quotation any further.

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

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

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

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

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

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

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

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

From the time we signed the articles, we were never left to ourselves. Truculent-looking men accompanied us to our several boarding houses, paid our debts for us, finally bringing us by boat to a ship lying out in the bay. As we passed under her stern, I read the name Cachalot, of New Bedford; but as soon as we ranged alongside, I realized that I was booked for the sailor's horror—a cruise in a whaler.

Badly as I wanted to get to sea, I had not bargained for this, and would have run some risks to get ashore again; but they took no chances, so we were all soon aboard. Before going forward, I took a comprehensive glance around, and saw that I was on board of a vessel belonging to a type which has almost disappeared off the face of the waters. A more perfect contrast to the trim-built English clipper ships that I had been accustomed to I could hardly imagine. She was one of a class characterized by sailors as "built by the mile, and cut off in lengths as you want 'em," bow and stern almost alike, masts standing straight as broomsticks, and bowsprit soaring upward at an angle of about forty-five degrees. She was as old-fashioned in her rig as in her hull. Right in the center of the deck, occupying a space of about ten feet by eight, was a square erection of brickwork, upon which my wondering gaze rested longest, for I had not the slightest idea what it could be. But I was rudely roused from my meditations by the harsh voice of one of the officers, who shouted, "Naow then, git below an' stow yer dunnage, 'n look lively up agin!" Tumbling down the steep ladder, I entered the gloomy den which was to be for so long my home, finding it fairly packed with my shipmates. The whole space was undivided by partition, but I saw at once that black men and white had separated themselves, the blacks taking the port side and the whites the starboard. Finding a vacant bunk by the dim glimmer of the ancient teapot lamp that hung amidships, giving out as much smoke as light, I hurriedly shifted my coat for a "jumper" or blouse, put on an old cap, and climbed into the fresh air again. Even *my* seasoned head was feeling bad with the villainous reek of the place. I had hardly reached the deck when I was confronted by a negro, the biggest I ever saw in my life. He looked me up and down for a moment, then opening his ebony features in a wide smile, he said: "Great snakes! why, here's a sailor man for sure! Guess thet's so, ain't it, Johnny?" I said "yes" very curtly, for I hardly liked his patronizing air; but he snapped me up short with "yes, *sir*, when yew speak to me, yew blank limejuicer. I'se de fourf mate of dis yar ship, en my name's Mistah Jones, 'n yew jest freeze on to dat ar, ef yew want ter lib long 'n die happy. See, sonny?" I *saw*, and answered promptly, "I beg your pardon, sir, I didn't know." "Ob cawse yew didn't know, dat's all right, little Britisher; naow jest skip aloft 'n loose dat fore-taupsle." "Ay, ay, sir," I answered cheerily, springing at once into the fore-rigging and up the ratlines like a monkey, but not too fast to hear him chuckle, "Dat's a smart kiddy, I bet." On deck I could see a crowd at the windlass heaving up anchor. I said to myself, "They don't waste any time getting this packet away." Evidently they were not anxious to test any of the crew's swimming powers. They were wise, for had she remained at anchor that night I verily believe some of the poor wretches would have tried to escape.

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

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

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

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

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

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

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

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

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

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

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

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

We lowered and left the ship, pulling right toward the school, the noise they were making in their fun effectually preventing them from hearing our approach. It is etiquette to allow the mate's boat first place, unless his crew is so weak as to be unable to hold their own; but as the mate always has first pick of the men this seldom happens. So, as usual, we were first, and soon I heard the order given, "Stand up, Louey, and let 'em have it!" Sure enough, here we were right among them. Louis let drive, "fastening" a whopper about twenty feet long. The injured animal plunged madly forward, accompanied by his fellows, while Louis calmly bent another iron to a "short warp," or piece of whale line, the loose end of which he made a bowline with round the main line which was fast to the "fish." Then he fastened another "fish," and the queer sight was seen of these two monsters each trying to flee in opposite directions, while the second one ranged about alarmingly as his "bridle" ran along the main line. Another one was secured in the same way, then the game was indeed great. The school had by this time taken the alarm and cleared out, but the other boats were all fast to fish, so that didn't matter. Now, at the rate our "game" were going, it would evidently be a long while before they died, although, being so much smaller than a whale proper, a harpoon will often kill them at a stroke. Yet they were now so tangled or "snarled erp," as the mate said, that it was no easy matter to lance them without great danger of cutting the line. However, we hauled up as close to them as we dared, and the harpooner got a good blow in, which gave the biggest of the three "Jesse," as he said, though why "Jesse" was a stumper. Anyhow, it killed him promptly, while almost directly after another one saved further trouble by passing in his own checks. But he sank at the same time, drawing the first one down with him, so that we were in considerable danger of having to cut them adrift or be swamped. The "wheft" was waved thrice as an urgent signal to the ship to come to our assistance with all speed, but in the meantime our interest lay in the surviving blackfish keeping alive. Should *he* die and, as was most probable, sink, we should certainly have to cut and loose the lot, tools included.

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

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

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

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

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

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

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

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

We were all gathered about the fo'lk'sle scuttle one evening, a few days after the gale referred to above, and the question of whale-fishing came up for discussion. Until that time, strange as it may seem, no word of this, the central idea of all our minds, had been mooted. Every man seemed to shun the subject, although we were in daily expectation of being called upon to take an active part in whale-fighting. Once the ice was broken, nearly all had something to say about it, and very nearly as many addle-headed opinions were ventilated as at a Colney Hatch debating society. For we none of us *knew* anything about it. It was Saturday evening, and while at home people were looking forward to a day's respite from work and care, I felt that the coming day, though never taken much notice of on board, was big with the probabilities of strife such as I at least had at present no idea of—so firmly was I possessed by the prevailing feeling.

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

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

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

By the time the oars were handled, and the mate had exchanged places with the harpooner, our friend the enemy had "sounded"—that is, he had gone below for a change of scene, marveling, no doubt, what strange thing had befallen him. Agreeably to the accounts which I, like most boys, had read of the whale-fishery, I looked for the rushing of the line round the loggerhead (a stout wooden post built into the boat aft), to raise a cloud of smoke with occasional bursts of flame; so, as it began to slowly surge round the post, I timidly asked the harpooner whether I should throw any water on it. "Wot for?" growled he, as he took a couple more turns with it. Not knowing "what for," and hardly liking to quote my authorities here, I said no more, but waited events. "Hold him up, Louey, hold him up, cain't ye?" shouted the mate, and to my horror, down went the nose of the boat almost under water, while at the mate's order everybody scrambled aft into the elevated stern sheets.

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

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

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

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

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

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

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

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

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

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

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

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

Two men were now told off as "blubber-room men," whose duty it became to go below and, squeezing themselves in as best they could between the greasy mass of fat, cut it up into "horse-pieces" about eighteen inches long and six inches square. Doing this, they became perfectly saturated with oil, as if they had taken a bath in a tank of it; for as the vessel rolled it was impossible to maintain a footing, and every fall was upon blubber running with oil. A machine of wonderful construction had been erected on deck in a kind of shallow trough about six feet long by four feet wide and a foot deep. At some remote period of time it had no doubt been looked upon as a triumph of ingenuity, a patent mincing machine. Its action was somewhat like that of a chaff-cutter, except that the knife was not attached to the wheel, and only rose and fell, since it was not required to cut right through the "horse-pieces" with which it was fed. It will be readily understood that, in order to get the oil quickly out of the blubber, it needs to be sliced as thin as possible, but for convenience in handling the refuse (which is the only fuel used) it is not chopped up in small pieces, but every "horse-piece" is very deeply scored as it were, leaving a thin strip to hold the slices together. This, then, was the order of work: Two harpooners attended the try-pots, replenishing them with minced blubber from the hopper at the port side, and baling out the sufficiently boiled oil into the great cooling tank on the starboard. One officer superintended the mincing, another exercised a general supervision over all. So we toiled watch and watch, six hours on and six off, the work never ceasing for an instant night or day. Though the work was hard and dirty, and the discomfort of being so continually wet through with oil great, there was only one thing dangerous about the whole business. That was the job of filling and shifting the huge casks of oil. Some of these were of enormous size, containing three hundred and fifty gallons when full, and the work of moving them about the greasy deck of a rolling ship was attended with a terrible amount of risk. For only four men at most could get fair hold of a cask, and when she took it into her silly old hull to start rolling, just as we had got one halfway across the deck, with nothing to grip your feet, and the knowledge that one stumbling man would mean a sudden slide of the ton and a half weight, and a little heap of mangled corpses somewhere in the lee scuppers—well, one always wanted to be very thankful when the lashings were safely passed.

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

SKETCH OF MANLY MILES.

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

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

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

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

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

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

"Dear Sir: As you have already furnished me with invaluable materials for the natural history of the fishes of your State, I am emboldened to ask another favor of you. I am preparing a map of the Geographical Distribution of the Turtles of North America, and would be greatly indebted to you for any information respecting the range of those found in your State, as far as you have noticed them, even if you should know them only by their common names, my object being simply to ascertain how far they extend over different parts of the country. If you could add specimens of them, to identify them with precision, it would be, of course, so much the better; but as I am almost ready for the press, I could not for this paper await the return of spring, but would thank you for what you could furnish me now. I am particularly interested in ascertaining how far north the different species inhabiting this continent extend." On the back of this letter was Dr. Miles's indorsement that a box had been sent.

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

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

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

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

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

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

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

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

Prof. Byron D. Halsted, of the New Jersey Agricultural College Experiment Station, who was an agricultural pupil of Dr. Miles in Lansing, characterizes him as having been a full man who knew his subjects deeply and fondly. "In those days I am safe in writing that he represented the forefront of advanced agriculture in America. He was in close touch with such men as Lawes and Gilbert, Rothamstead, England, the famous field-crop experimenters of the world, and as for his knowledge of breeds of live stock and their origin, Miles's

Stock-Breeding is a classic work. Dr. Miles, in short, was a close student, a born investigator, hating an error, but using it as a stepping-stone toward truth. He did American farming a lasting service, and his deeds live after him."

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

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

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

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

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

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

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

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

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

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

Editor's Table.

SCIENCE AND CULTURE.

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

It may be questioned, however, whether we have as yet thoroughly adapted our educational methods to this change of standpoint. Do we as yet take a sufficiently broad view of life? If we conceive life narrowly as essentially a business struggle, and adapt our procedure to that conception, the results will show very little relation to the larger and truer conception according to which life means development of faculty, activity of function, and a harmonious adjustment of relations between man and man. If, again, we make too much of knowledge that has only a conventional value, having little or no bearing on the understanding of things or the accomplishment of useful work, we are so far falling into the old error of "learning for school." The address by Sir Archibald Geikie, which we published last month, gives a useful caution against undervaluing "the older learning." The older learning can certainly be made an effective instrument for the cultivation of taste, of sympathy, and of intellectual accuracy along certain lines. It tends further, we believe, to promote a certain intellectual self-respect, which is a valuable quality. In the study of language and literature the human mind surveys, as it were, its own peculiar possessions, and thus acquires a sense of proprietorship which a study of the external world can hardly give. Still, it is well to cultivate a consciousness of the essentially limited and arbitrary nature of such knowledge. It is important, we may admit, to have a good text of such an author as Chaucer; but the minutiæ into which critics of his text enter can not be said to possess any broad human interest. Whether he wrote this word or that word, adopted this spelling or that, can not be a question on which much depends; and could one know the exact truth on a thousand such points, he would not really be much the wiser. Among Chaucer scholars he could speak with a good deal of confidence; but the knowledge of these details would not really help to round out any useful *system* of knowledge, nor could any single fact possess the illuminating power which sometimes belongs to some single and, at first sight, unimportant fact in the realm of natural knowledge.

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

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

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

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

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

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

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

SURVIVAL OF THE FITTEST.

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

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

Scientific Literature.

SPECIAL BOOKS.

The study of the methods through which the topographical features and rock forms of particular districts have been worked out, as presented in numerous popular monographs, is a fascinating one; and we can hardly doubt that many persons who would never otherwise have thought of it have been made interested in geology by some of these masterly picturesque descriptions of regions with which they were superficially familiar. Other treatises on the origin of surface features, dealing with the subject more fundamentally, but likewise of limited scope, are not wanting. Yet, as Prof. *James Geikie* well says, there is no English work to which readers not skilled in geology can turn for a general account of the whole subject. Professor Geikie has therefore prepared his elaborate book on *Earth Sculpture* * to supply this want, to furnish an introductory treatise for those persons who may be desirous of acquiring some broad knowledge of the results arrived at by geologists as to the development of land forms generally. A vast number of geological questions are involved in the exhaustive treatment of the subject. All the forces with which geologists become acquainted in the study of the earth, and their operation, come into consideration. The effects of these forces assume aspects that vary according to the nature of the material on which they operate, and they are again modified according to the peculiar combinations of forces at work. The subject is therefore not the easy one it may be supposed at first sight to be, and the reader who peruses Professor Geikie's work with the intention of mastering it will find he has some studying to do. Yet Professor Geikie is clear, and it is only because he has gone deeper than the others that he may be harder. The first point he insists upon is that in the fashioning of the earth's surface no hard-and-fast line separates past and present. The work has been going on for a long time, and is still in progress, under a law of evolution as true for the crust of the globe as for the plants and animals. In setting out upon our inquiry we must in the first place know something about rocks and the mode of their arrangement, of the structure or architecture of the earth's crust. This leads to the distinction between the igneous and the subaqueous, the volcanic, plutonic, and metamorphic, and the derivative rocks on which epigene agencies have performed their shaping work. These rocks have been modified in various ways, and the surface appearance of the earth has been affected by forces operating from the interior, and by external factors, the work of which is called denudation. The agents of denudation are described—air, water, heat, frost, chemical action, plants, and animals—often so closely associated in their operations that their individual shares in the final result can hardly be determined. The various influences of these factors as exerted upon different forms of geological structure and different sorts of rocks are then taken up and described as applied to land forms in regions of horizontal, or gently inclined, and of highly folded and disturbed strata, and in regions affected by normal faults or vertical displacements. Land forms due directly or indirectly to igneous action and the influence of rock character on the determination of land forms are subjects of special chapters. Glacial action is one of the most important factors in modifying the forms of northern lands, and is treated with considerable fullness. Æolian action —of the air and wind—has peculiar and important effects in arid regions, and underground water in limestone districts, and these receive attention. Then come basins—those due to crustal deformation, crater lakes, river lakes, glacial basins, and others, and coast lines. Finally, a classification is given of these land forms as plains or plateaus of accumulation and of erosion, original or tectonic and subsequent or relict hills and mountains, original or tectonic and subsequent or erosion valleys, basins, and coast

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

lines, and the conclusions are reached that we do not know, except as a matter of probability, whether we have still visible any original wrinkles of the earth's crust; and that some of the estimates of the time it has taken to produce the changes of which we witness the results have been very much exaggerated.

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

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

The soul of the race is best expressed in its art, not in its history or institutions, and, as it can not bequeath its soul, so it can not impress its civilization or art upon an alien race. It was on account of this incompatibility of soul that Grecian art failed to be implanted in India. The unaltering constituent of the soul corresponds to character, while intellectual qualities are variable. By character is meant perseverance, energy, power of self-control, also morality. The latter is hereditary respect for the rules on which a society is based. This definition would make polygamy a moral notion for Mormons. The knowledge of character "can be acquired neither in laboratories nor in books, but only in the course of

* The Psychology of Peoples. By Gustave Le Bon. New York: The Macmillan Company. Pp. 236. Price, $1.50.

long travel." Whence it is learned that different races can not have mutual comprehension. Luckily for the student who is unable to travel, the same phenomenon may be observed in the gulf that separates the civilized man and woman. Although highly educated, "they might converse with each other for centuries without understanding one another." These differences between races and individuals demonstrate the falsity of the notion of equality. Indeed, through *science* "man has learned that to be slaves is the natural condition of all human beings." Naturally he becomes dispirited, anarchy seizes upon the uneducated and sullen indifference the more cultivated. "Like a ship that has lost its compass, the modern man wanders haphazard through the spaces formerly peopled by the gods and rendered a desert by science." In France morality is gradually dying out, while the United States is threatened by a gigantic civil war. What to do is problematical, since we are informed "that people have never derived much advantage from too great a desire to reason and think," and what is most harmful to a people is to attain too high a degree of intelligence and culture, the groundwork of the soul beginning to decline when this level is reached. The remedy suggested to us is "the organization of a very severe military service and the permanent menace of disastrous wars." But if we fail to see the improving tendency of this advice, it is probably because we are like historians, "simple-minded," while Dr. Le Bon is much too complex for our understanding. According to his own theory, there is no hope that we may comprehend him, since the outpourings of a soul of the Latin race can not be transferred by a simple bridge of translation to the apprehension of an Anglo-Saxon mind, separated, as he would term it, by "the dead weight of thousands of generations."

GENERAL NOTICES.

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

* A Text-Book of Mineralogy, with an Extended Treatise on Crystallography and Physical Mineralogy. By Edmund Salisbury Dana. New edition, entirely rewritten and enlarged. New York: John Wiley & Sons. Pp. 593. $4.

The title, *The Story of the Railroad*,* carries with it the suggestion of an eventful history. The West, in the author's view, begins with the Missouri River. The story of its railroad is the story of the line, now very multiple, that leads to the Pacific Ocean. The beginning of white men's travels in these routes is traced by the editor to the Spanish adventurers of the sixteenth century,

* The Story of the Railroad. By Cy Warman. New York: D. Appleton and Company (Story of the West Series). Pp. 280. Price, $1 50.

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

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

Mr. *George Jacob Holyoake* has written with much enthusiasm the *Jubilee History of the Leeds Industrial Co-operative Society.* * Many schemes have been started on lines similar to those of this one, but very few besides it have grown from the very beginning, and, having become to all appearance a permanent institution, can look back upon a career of fifty years with complete satisfaction. The society began in times of public distress. The ground was prepared for it by the "Redemption" Society, which was founded at Leeds in 1845, by admirers of Robert Owen, after the experiment at Queens-

* Infinitesimal Analysis. By William Benjamin Smith. Vol. I. Elementary; Real Variables. New York: The Macmillan Company. Pp. 352. $3.25.

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

wood had failed. It practiced a kind of co-operation and had some distinguished friends to wish it well. Among the speakers at its meetings was Dr. Frederic Hollick, still living, now a resident of New York city. The co-operative society was started as a means of getting cheaper flour for its members. On February 25, 1847, an appeal headed "Holbeck Anti Corn Mill Association" was issued to the working classes of Leeds and vicinity by the "working people of Messrs. Benyon & Co.'s mill," Holbeck, inviting combination and subscriptions for establishing a mill to be the property of the subscribers and their successors, "in order to supply them with flour and flour only." Meetings were held, an organization was effected, and the mill was started. The history of the society and how it grew, how "flour only" was stricken from its scheme and other things were added and it branched out, how co-operative stores were established, how it gained the confidence of the public and the respect of rivals in business, its successes and its mistakes, its triumphs and failures, are told by Mr. Holyoake, year by year, in a detail in which everything is set down and nothing covered up. In 1897 the cooperative society had productive departments of flour, bakery, bespoke clothing, boot and shoe factory, brush factory, cabinet making, building, millinery, and dressmaking, employing 541 hands and turning over £26,-949; 80 large stores for the sale of these and various other kinds of goods in Leeds and vicinity; drapery branches and boot and shoe stores; 43 butchering branches; and 37,000 subscribing purchasers. Its capital stood at £447,000; and its sales for the year amounted to £1,042,616.

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

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

The *Psychologie als Erfahrungs-Wissenschaft* of *Hans Cornelius* is not intended for a complete account and review of the facts of psychical life, but rather to present the fundamentals of a purely empirical theory, excluding all metaphysical views. Such an account should not start from any arbitrary abstractions or hypotheses, but simply from actually ascertained, directly perceived psychical experiences. On the other hand, an empirical definition should be required for all the terms that are used in a comprehensive description of the experience; and on term should be used without the psychical manifestation described by it being pointed out. After an introduction in which the method and place of psychology, subjective and objective, physiological and genetic, are referred to, the elementary facts of consciousness are discussed. The coherency of knowledge is treated of in the next chapter, and in the third, Psychical Analysis and the conception of unobserved consciousness; and the succeeding chapters are devoted to Sensation, Memory, and Fancy; The Objective World, Truth and Error, and Feeling and Will. (Published at Leipsic, Germany: B. G. Teubner.)

An extremely interesting book is given us in the publications of the Wisconsin Geological and Natural History Society of studies by *George W.* and *Elizabeth Peckham*, of the *Instincts and Habits of the Solitary Wasps.* These insects are familiar enough to us all, as we meet them or see their nests of one or a few cells every day, and then think no more of them. But Mr. and Mrs. Peckham, following them to their haunts and keeping company with them, have found them manifesting remarkable instincts and exercising curious customs, which they describe in the style of persons who are in love with their work. The opportunity for the studies was given in two gardens, one on the top of a hill and the other lower down, with an island in a lake close by and acres of woodland all about, offering a rich variety of nesting places. There are more than a thousand species of these solitary wasps in the United States, to only about fifty of the social ones, and they live without knowledge of their progenitors and without relations with others of their kind.

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

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

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

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

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

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

A Geological Reconnoissance of the Coal Fields of the Indian Territory, published in the Contributions to Biology of the Hopkins Seaside Laboratory of Leland Stanford Junior University, by *Noah Fields Drake*, is based upon a six months' examination made by the author during the spring, summer, and fall of 1896, of the larger part of the coal measures and adjacent formations of Indian and Oklahoma Territories. The best maps that could then be had being exceedingly inaccurate, sketch maps were made of areas that were especially important. On account of features of particular geological interest, nearly all the area south and east of the Canadian River and the bordering areas of the Boone chert and limestones were sketched and studied rather closely.

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

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

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

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

PUBLICATIONS RECEIVED.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Fragments of Science.

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

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

Poisonous Plants.—Statistics in regard to poisonous plants are lacking on account of a general ignorance of the subject, and it is therefore impossible to form even an approximate estimate of the damage done by them. Besides the criminal uses that may be made of them, there are some other problems connected with them that are of general public interest. The common law of England holds those who possess and cultivate such plants responsible for damages accruing from them; and a New York court has awarded damages in a case of injury from poison ivy growing in a cemetery. In order to obtain information on the subject, the botanical division of the Department of Agriculture arranged to receive notices through the clipping bureaus of the cases of poisoning recorded in the newspapers. Thus through the persons named in the articles or through the local postmaster it was put in correspondence with the physician in the case, who furnished the authentic facts. A large number of correct and valuable data were thus secured. It is proved by these facts that all poisonous plants are not equally injurious to all persons nor to all forms of life. Thus poison ivy has no apparent external effect upon animals, and a few of them eat its leaves with impunity; and it acts upon the skin of the majority of persons with varying intensity — on some hardly at all, while others are extremely sensitive to it. A similar variability is found in the effects of poisonous plants taken internally. In some cases often regarded as of that kind, death is attributable not to any poison which the plant contains, but to immoderate or incautious eating, or to mechanical injury such as is produced in horses by the hairs of crimson clover, or to the effect of parasitic growths, such as ergot on rye. Excluding all which operate in these ways, there are, however, a large number of really poisonous plants, the properties of which are comparatively unknown. It is concerning these that information has been sought by the botanical division. Its report contains descriptions of about forty plants, with figures, belonging to seventeen families.

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

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

Portland Cement.—The following facts are taken from an address delivered before the Franklin Institute by Mr. Robert W. Lesley: "It was not until the end of the last century that the true principles of hydraulic cement were discovered by Smeaton, who, in the construction of the Eddystone Lighthouse, made a number of experiments with the English limestones, and laid down, as a result, the principle that a limestone yielding from fifteen to twenty-five per cent of residue when dissolved in hydrochloric acid will set under water. These limestones he denominated hydraulic limestones, and from the principle so laid down by him come the two great definitions of what we now know as cement, namely, the natural and artificial cements of commerce. The natural variety, such as the Rosendale, Lehigh, and Cumberland cements, was first made by Joseph Parker in 1796, who discovered what he called 'Roman cement,' based upon the calcination at low temperatures of the nodules found in the septaria geological formation in England. This was practically the first cement of commerce, and gave excellent results. Joseph Aspdin, a bricklayer or plasterer, took out a patent in England in 1824 on a high-grade artificial cement, and, at great personal deprivation, succeeded in manufacturing it on a commercial scale by combining English chalks with clay from the river beds, drying the mixed paste, and after calcining at high heat the material thus produced, grinding it to powder. This cement, which was the first Portland cement in the market, obtained its name from its resemblance when it became stone to the celebrated Portland stone, one of the leading building materials in England. The rocks used in the manufacture of Portland cement are very similar to those from which natural cement is made. The various layers in the natural rock may vary in size or stratification, so that the lime, alumina, and silica may not be in position to combine under heat, or there may be too much of one ingredient, or not enough of the others in close proximity to each other. In making Portland cement, these rocks, properly proportioned, are accordingly ground to an impalpable powder, the natural rock being broken down and the laminæ distributed in many small grains. This powder is then mixed with water, and is made into a new stone in the shape of the brick, or block, in which all the small grains formerly composing the laminæ of the original rock are distributed and brought into a close mechanical juxtaposition to each other. The new rock thus made is put into kilns with layers of coke, and is then calcined at temperatures from 1,600° to 1,800°. The clinker, as it comes from the kiln, is then crushed and ground to an impalpable powder, which is the Portland cement of commerce. Portland cement may be made from other materials, such as chalk and clay, limestone and clay, cement rock and limestone, and marls and clays. In every case the principle is the same, the breaking down and the redistributing of the materials so that the fine particles may be in close mechanical union when subjected to the heat of the kiln."

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

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

The Atlantic Slope.—The Atlantic slope of the United States is described in the New Jersey State Geological Survey's report on the Physical Geography of the State as "a fairly distinct geographical province. Its eastern boundary is the sea; its western boundary on the north is the divide between the drainage flowing southeast to the sea and that flowing northeast to the St. Lawrence. Farther south its western limit is the divide between the streams flowing east to the Atlantic and those flowing west to the Ohio and Mississippi Rivers." The line between it and the geographical province next west follows the watershed of the Appalachian system of mountains. It is divided, according to elevations, into several subprovinces, all of which elongate in a direction roughly parallel to the shore. Next to the coast there is usually a belt of lowland, few or many miles wide, called the *Coastal Plain.* Inland from the Coastal Plain is an intermediate height, between the Coastal Plain to the east and the mountains to the west, known in the South as the *Piedmont Plateau.* The mountainous part of the slope constitutes the third province, known as the *Appalachian Zone.* The Atlantic slope may be divided into two sections—a northern and a southern—in which the Coastal Plain is narrow and wide respectively. These two sections meet in New Jersey, where the division runs from the Raritan River, just below New Brunswick, to Trenton. South of this line the Coastal Plain expands, and all considerable elevations recede correspondingly from the shore. These three subprovinces are especially well shown in the southern section of the Atlantic slope. They are less well developed in the northern section, and even where the topography is comparable the underlying rock structure is different. In New Jersey a fourth belt, the Triassic formation, is interposed between the Coastal Plain and the Highlands corresponding to the Piedmont Plateau. North of New Jersey the Coastal Plain has little development, though Long Island and some small areas farther east and northeast are to be looked upon as parts of it.

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

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

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

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

MINOR PARAGRAPHS.

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

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

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

The first section of the electric railway up the Jungfrau, which is intended to reach the top of the mountain, was opened about the first of October, 1898. The line starts from the Little Scheidegg station of the existing Wengern Alp Railway, 6,770 feet above the sea, and ascends the mountain masses from the north side, passing the Eiger Glacier, Eiger Wand, Eismeer, and Jungfraujoch stations, to Lift, 13,430 feet, whence the ascent is completed by elevator to the summit, 13,-670 feet. The road starts on a gradient of ten per cent, which is increased to twenty per cent about halfway to the Eiger Glacier station, and to twenty-five per cent, the steepest, after passing that station. There are about 85 yards in tunnel on the section now opened, but beyond the Eiger Glacier the road will not touch the surface except at the stations. About 250 yards of the long tunnel have been excavated so far. The stations beyond Eiger Wand will be built within the rock, and will be furnished with restaurants and beds. At the Eiger Wand and Eismeer stations passengers will contemplate the view through windows or balconies from the inside; but at the Jungfraujoch station tourists will be able to go out and take sledges for the great Aletsch Glacier. The cars will accommodate forty passengers each, and the company expects to complete the railroad by 1904.

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

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

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

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

NOTES.

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

C. Drieberg, of Colombo, Ceylon, records, in Nature, a rainfall at Nedunkeni, in the northern province of Ceylon, December 15 and 16, 1897, of 31.76 inches in twenty-four hours. The highest previous records, as cited by him, are at Joyeuse, France, 31.17 inches in twenty-two hours; Genoa, 30 inches in twenty-six hours; on the hills above Bombay, 24 inches in one night; and on the Khasia Hills, India, 30 inches in each of five successive days. The average annual rainfall at Nedunkeni has been 64.70 inches, but in 1897 the total amount was 121.85 inches. The greatest annual rainfall is on the Khasia Hills, India, with 600 inches. The wettest station in Ceylon is Padupola, in the central province, with 230.85 inches as the mean of twenty-six years, but in 1897 the amount was 243.07 inches.

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

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

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

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

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

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

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

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

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

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

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

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VOL. LIV.] ESTABLISHED BY EDWARD L. YOUMANS. [No. 1.

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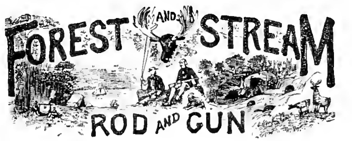

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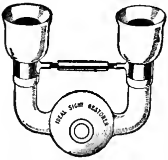

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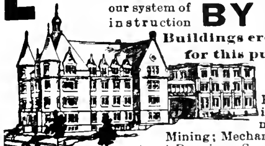

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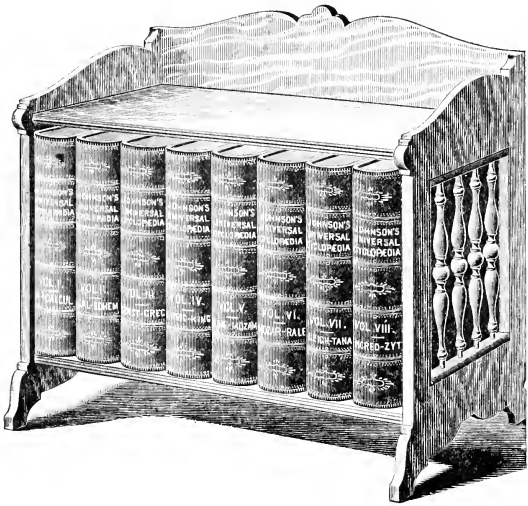

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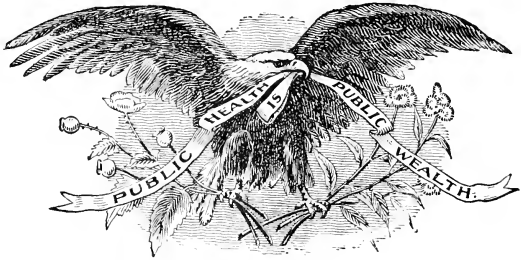

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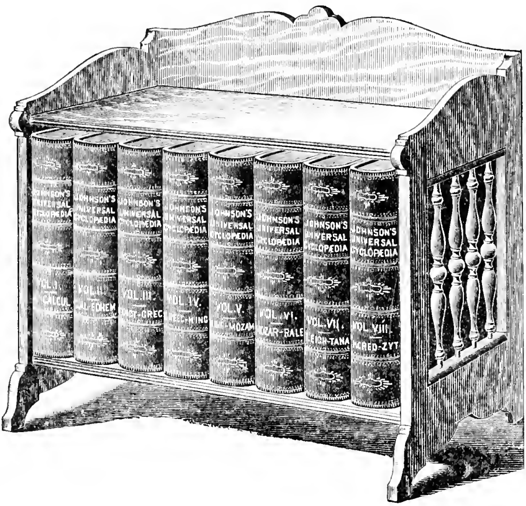

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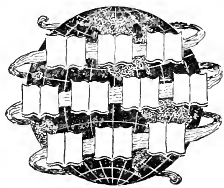

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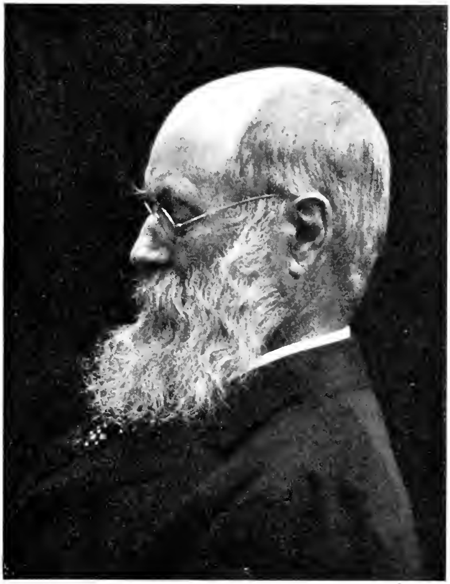

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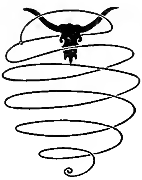

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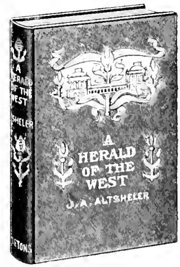

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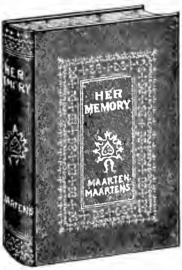

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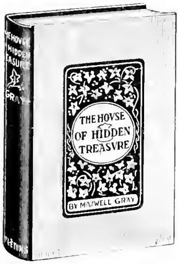

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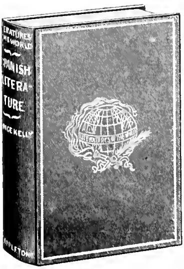

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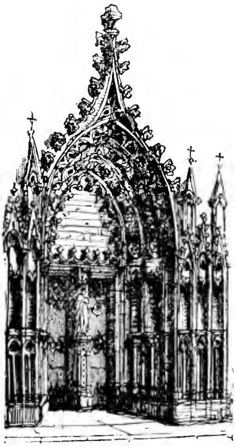

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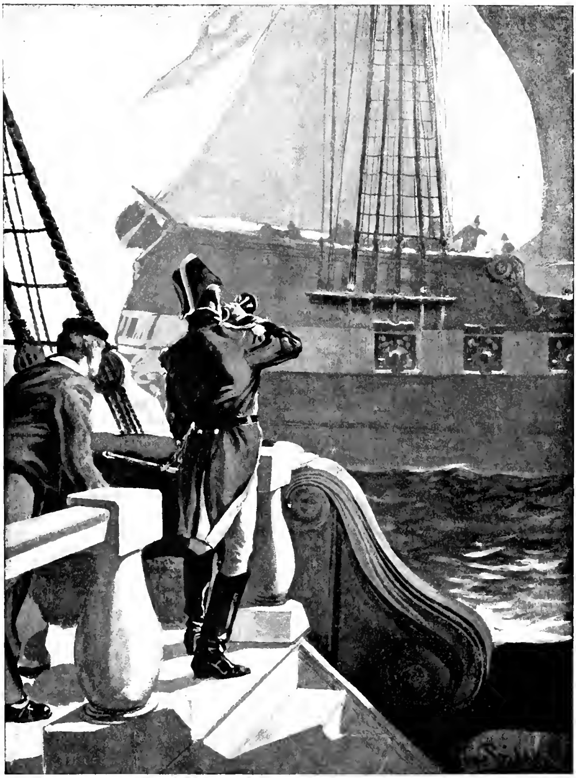

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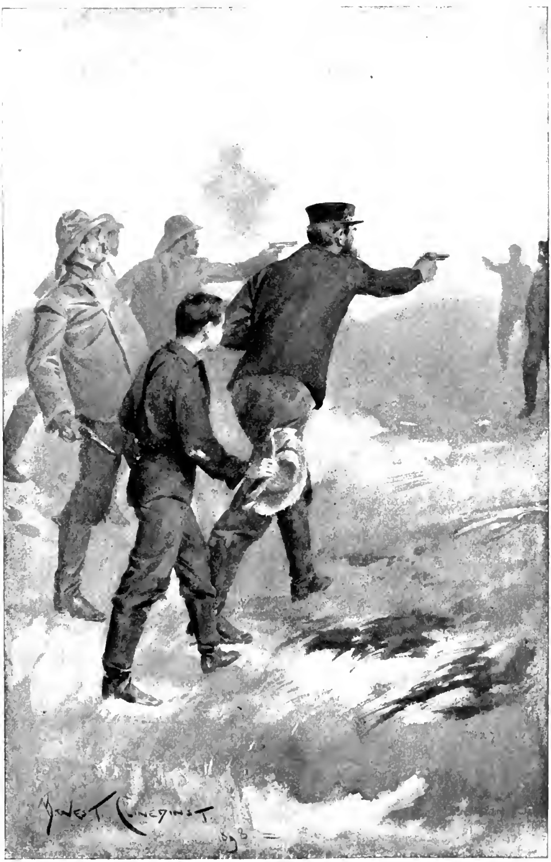

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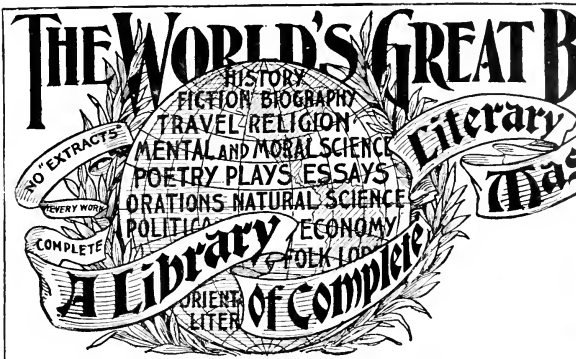

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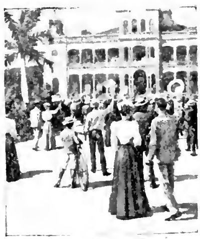

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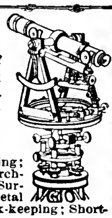

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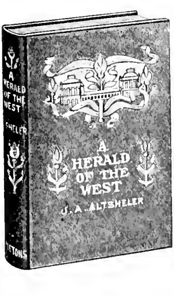

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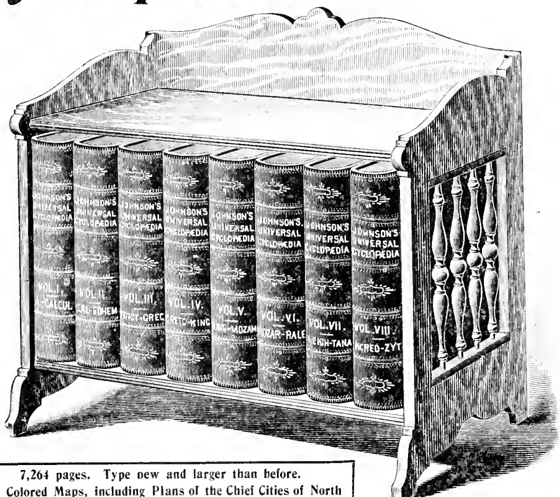

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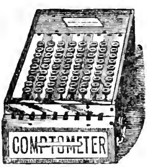

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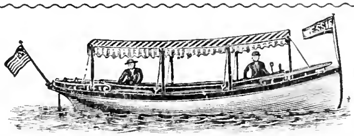

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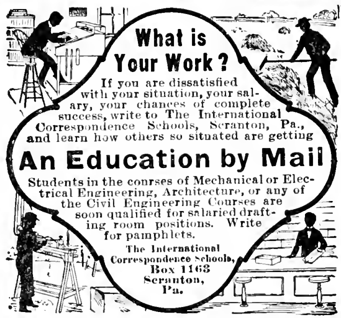

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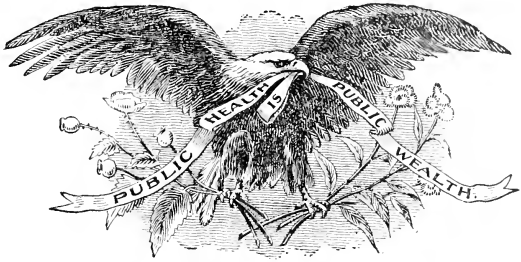

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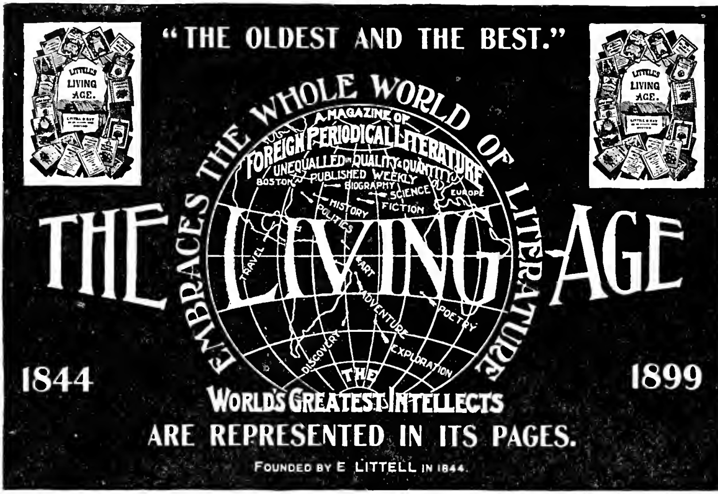

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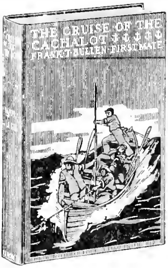

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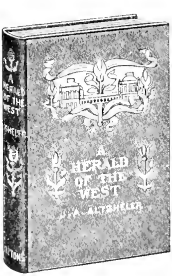

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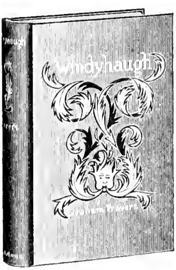

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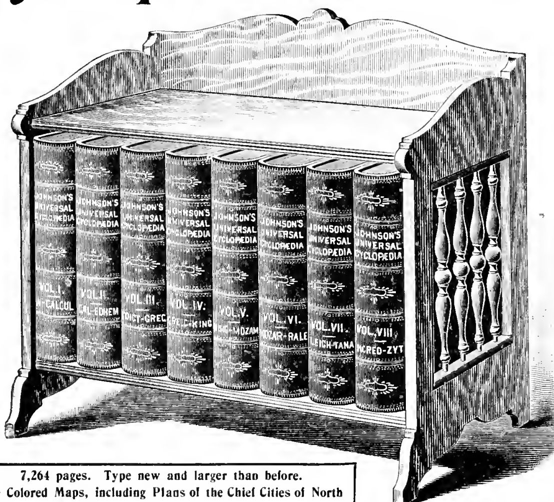

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EDITED BY WILLIAM JAY YOUMANS.

Prospectus for 1899.

THE scientific method of study and investigation is every year being more and more widely applied, drawing within its range, besides the endless succession of phenomena in physical Nature, many practical questions relating to agricultural and industrial development, civil administration, criminal reform, educational methods, public and private hygiene, and the ethics of social life. The results of such study are changing for the better man's operations in every field of activity, and in proportion as they are made known may they be expected to still further contribute to the material welfare and intellectual advancement of society. The contents of the Popular Science Monthly for 1899 will include an increasing variety of readable popular articles on these and allied subjects from writers of the foremost rank in their respective departments of science.

EDUCATION.

Special attention will, as heretofore, be given to the rôle of science in Education. A few of the topics coming under this head will be: The training of science teachers; the place of science in education; practical aspects of mental fatigue; teaching science in the common schools; instruction of the feeble-minded, etc.

NATURAL HISTORY.

As subjects of scientific study that are of never-failing interest, well calculated to develop the observing powers and the judgment, and easily accessible independently of the schools, liberal space will be given to articles on natural history, including curious forms of plant and animal life, and those varied aspects of Nature that present themselves in the geological and physiographic features of the landscape.

SOCIOLOGY.

Questions pertaining to social welfare, especially in those cases where the direct action of the state is concerned, will likewise receive a fair share of attention. These will embrace, among others, articles on the results of temperance legislation; the restriction of vivisection; state *versus* private philanthropy; and politics as an agency in social affairs.

THE PHYSICAL SCIENCES.

Care will be taken to keep up with the more important and later developments in the physical sciences, when they are susceptible of popular statement; wireless telegraphy, the applications of low temperatures in research, improvements in the industrial arts, and the history and later practical applications of electricity being among the special subjects that will receive attention.

SERIALS.

Several papers yet remain of the series by the late Hon. David A. Wells on The Principles of Taxation, that will appear early in the year. Professor Ripley's contributions on The Racial Geography of Europe will run into the year, and there are two more articles on The Evolution of Colonies, by Mr. James Collier.

With other illustrations, each number of the MONTHLY contains a finely engraved portrait of some eminent man of science, with a biographical sketch.

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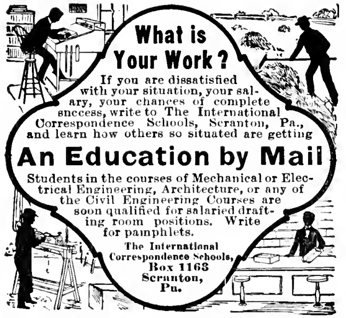

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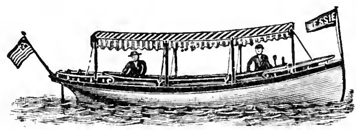

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Spring Announcements
1899

D. APPLETON & COMPANY'S

MONTHLY BULLETIN

D. APPLETON & CO.,
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Appletons' Monthly Bulletin.

MESSRS. D. APPLETON AND COMPANY'S spring announcements include the following books:

History of the People of the United States, by Prof. J. B. McMaster, Vol. V, covering the period from 1821 to 1837.

A History of American Privateers, by Edgar S. Maclay, uniform with "A History of the United States Navy."

The Principles of Taxation, by David A. Wells.

Outlines of the Comparative Physiology and Morphology of Animals, by Joseph Le Conte. Illustrated.

The Reminiscences of a Very Old Man (1808–1897), by John Sartain, illustrated.

Admiral Porter, by J. R. Soley, a new volume in the Great Commanders Series.

A Duet, with an Occasional Chorus, by A. Conan Doyle.

A Double Thread, by Ellen Thornycroft Fowler, author of "Concerning Isabel Carnaby."

The Mormon Prophet, by Lily Dougall.

Love among the Lions, by F. Anstey.

Snow on the Headlight, a Story of the Great Burlington Strike, by Cy Warman.

Idylls of the Sea, by Frank T. Bullen, F. R. G. S., First Mate, author of "The Cruise of the Cachalot."

The Story of Geographical Discovery, by Joseph Jacobs.

The Procession of Life, by Horace Annesley Vachell.

By Berwen Banks, by Allen Raine.

Pharos, the Egyptian, by Guy Boothby.

Paul Carah, Cornishman, by Charles Lee.

Pursued by the Law, by J. Maclaren Cobban.

Madame Izan, a Tourist Story, by Mrs. Campbell-Praed.

The Kingdom of Hate, by T. Gallon.

Lady Barbarity, by J. C. Snaith.

A Cosmopolitan Comedy, by Anna Robeson Brown.

Letters to a Mother, by Susan E. Blow. International Education Series.

Education by Development, by Friedrich Froebel. International Education Series.

Montaigne's Education of Children, by Dr. L. R. Rector. International Education Series.

Spain, by F. A. Ober. History for Young Readers.

Our Navy in War Time, by Franklin Matthews. Illustrated. Appletons' Home-Reading Books.

Uncle Sam's Soldiers, by O. P. Austin. Illustrated. Appletons' Home-Reading Books.

Harold's Quest, by J. W. Troeger. Illustrated. Appletons' Home-Reading Books.

About the Weather, by Mark W. Harrington. Illustrated. Appletons' Home-Reading Books.

The Story of the Fishes, by J. N. Baskett. Illustrated. Appletons' Home-Reading Books.

The Spanish Method to Learn French. After the System of Ollendorff. By T. Simonné.

Nervous Diseases, by Dr. Ludwig Hirt, Professor at the University of Breslau. Illustrated.

A Text-Book of Ophthalmology, by Dr. Ernest Fuchs, Professor of Ophthalmology in the University of Vienna. Illustrated.

Electro-hæmostasis, by A. J. C. Skene, M. D., LL. D., Professor of Gynæcology in the Long Island College Hospital.

Anatomy and Physiology of the Nervous System, by L. F. Barker, M. B., Associate Professor of Anatomy in the Johns Hopkins Medical School.

Prof. John Bach McMaster.

The fifth volume of Prof. J. B. McMaster's *History of the People of the United States* will cover the time of the administrations of John Quincy Adams and Andrew Jackson, and will describe the development of the democratic spirit, the manifestations of new interest in social problems, and the various conditions and plans presented between 1825 and 1837. To a large extent the intimate phases of the subjects which are treated have received scant attention heretofore. A peculiar interest attaches to the various banking and financial experiments proposed and adopted at that time, to the humanitarian and socialistic movements, the improvements in the conditions of city life, to the author's full presentation of the literary activity of the country, and his treatment of the relations of the East and West. Many of these subjects have necessitated years of first-hand investigation and are now treated adequately for the first time.

The volume opens with a chapter on the early settlement of Texas by Austin and his imitators, and on the origin and first temporary settlement of the Oregon dispute by the establishment of the line 54° 40′. It was in connection with this line that Adams announced to Russia the anti-colonization part of the Monroe Doctrine.

The second chapter, therefore, under the caption Growth of the Monroe Doctrine, reviews the gradual development and assertions of the three principles of that doctrine from Washington's day to 1823; the Holy Allies and their work in Europe, their preparation for interference with the late Spanish-American colonies, and the final assertion of the doctrine of Monroe.

After thus reviewing the important foreign relations of Monroe's second term, Mr. McMaster returns to domestic concerns, and in the next chapter treats of The Breaking Up of the Republican Party. The economic, industrial, and political conditions which led to sectionalism, the rise of the rival candidates, and the long presidential campaign ending in the failure of the colleges to elect, are given with great fullness.

The election of Adams marked the end of the first half century of the republic. The next eight chapters are therefore given up to an examination or review of certain social, political, literary, and industrial conditions which arose during the period and paved the way for the triumph of Jackson and democracy.

In the chapter on Socialistic and Labor Reforms we have the story of the entrance of the workingman into politics; of that curious socialistic movement of Owen and Fanny Wright; the Owenite communities at New Harmony and elsewhere; the rise of "Workeyism" and "Free Inquiry"; the beginning of the Antimasonic party, and the early signs of native Americanism.

The next chapter is a full account of The State of the Country from 1825 to 1829: the rapid growth of cities; early problems in city government; the introduction of gas and anthracite coal, the opening of the Erie Canal and the tremendous struggle for Western trade; the early railroad schemes; the great questions of internal improvements at Federal expense; descriptions of life on the Western frontier; the long struggle between the Old Court and and the New Court parties in Kentucky; the rise of the cotton industry in the South and Southwest; the Indian troubles in Georgia, and the quarrel between that State and the Executive.

Following this is a chapter on The Negro Problem, reviewing the long history of the status of the free negro; the slave; the work of the Colonization Society, of the abolition societies, the anti-slavery societies; and the troubles in South Carolina, Georgia, and the District of Columbia growing out of slavery issues.

The next chapter, under the title The Industrial Revolution, is an account of the rise and development of manufactures; of the conditions which led to the tariffs of 1824 and 1828; their peculiar characters; the violent opposition of the South, and assertions of the State-Rights Doctrine of Calhoun and his party.

Next comes a chapter on our Early Literature, treating of our native authors, the struggle to establish magazines and periodicals, and the differentiation of the magazine from the all-around monthly to the literary, the religious, the legal, the medical, the scientific; the appearance of later authors—Bryant, Cooper, Sparks, Longfellow, Irving, and a host now forgotten.

There is a chapter on The Common Schools during the first half century, and another, quite timely now, on British Criticism of the United States, setting forth very fully why our fathers hated Great Britain so heartily. Then follows an elaborate review of Political Ideas during the first half century. Then comes a chapter on foreign complications—the Panama Congress; the prevention of the independence of Cuba by the United States in the interest of the slaveholding States; the Maine boundary dispute with Great Britain; the Oregon agreement of 1827; and, finally, a chapter on The Triumph of Democracy, detailing the famous struggle ending in the election of Jackson, and his war on the Bank.

The period covered in the volume is one of great interest, and has never before been treated so fully, nor from so many points of view.

Edgar Stanton Maclay.

The *History of American Privateers*, which has engaged the attention of Mr. Edgar S. Maclay for the last few years, will be published late in the spring or in the early autumn. The stirring tale of the exploits of American privateersmen has never been fully told, and Mr. Maclay's work will place before the public a little-known chapter of our maritime history. In his preface Mr. Maclay says:

"The history of the United States Navy is so intimately connected with that of our privateers that the story of one would be incomplete without a full record of the other. In each of our wars with Great Britain many of the captains in the navy assumed command of privateers in which they frequently rendered services of national importance, while the pivateersmen furnished the navy with a large number of officers, many of whom became famous. In our struggle for independence more than sixty American privateers were commanded by men who had been, or soon became, officers in the regular service, and in more than one instance—notably that of the officers and men of the Ranger, Captain John Paul Jones's famous ship, then commanded by Captain William Simpson—almost the entire ship's company of a Continental cruiser turned to privateering. Many of our most distinguished navy officers have pointed with pride to their probationary career in privateers. The mere mention of such names as Truxton, Porter, Biddle, Decatur, Barney, Talbot, Barry, Perry, Murray, Rodgers, Cassin, Little, Robinson, Smith, and Hopkins will show how closely related were the two arms of our maritime service.

"In the War of 1812 the regular navy of the United States on the ocean numbered only twenty-three vessels, carrying in all five hundred and fifty-six guns. This force captured two hundred and fifty-four of the enemy's craft. In the same period we had five hundred and seventeen privateers, aggregating two thousand eight hundred and ninety-three guns, which took no fewer than thirteen hundred prizes.

"Looking at it from the financial point of view, we find that the money value of the prizes and cargoes taken by the Government cruisers during the Revolution—allowing an average of thirty thousand dollars for each—to be no less than six million dollars, and allowing the same average for the privateers, we have a total of eighteen million dollars. In the second war with Great Britain we find, on the same basis of calculation, the money value of Government prizes to be six million six hundred thousand dollars, while that of the privateers was thirty-nine million dollars. Taking the entire maritime forces of the United States, both navy and privateers, into consideration, we find that about eight hundred vessels were captured from the English in the War for Independence, valued at twenty-three million eight hundred and eighty thousand dollars, while the prisoners could not have been short of sixteen thousand; and in the second war against Great Britain the value of the prizes was forty-five million six hundred thousand dollars, while there were no fewer than thirty thousand prisoners. Against these figures we have some twenty-two thousand prisoners taken by our land forces during the Revolution, and about six thousand taken in the War of 1812."

* * *

The rank which Mr. Maclay's *History of the United States Navy* has earned for itself as the one final and authoritative work upon the subject is a sufficient guarantee of the treatment which the historian will give to the Spanish-American War. Neither the author nor publishers would consent to the making of a "timely" book, hastily prepared from newspaper articles. Very recently the appearance of reports and other papers in this country and in Spain has amply justified adherence to true historical methods. The official documents relating to the war, the various monographs, published logs, and special reports, and the accounts of officers who took a leading part in the war, have been carefully collected by Mr. Maclay, and his history will represent a sifting of evidence and a free access to revised and reliable data which no other writer on the entire subject can equal. Mr. Maclay is also enjoying the advantage of the aid afforded by some of the chief actors in the scenes which he describes. The publishers announce that the new edition of the "History of the Navy," to appear probably in the autumn, will be in three volumes. The second volume will close with the Civil War. The third volume will include naval experiences since the Civil War, the building of the new navy, and the history of the Spanish-American War in full, including the work of the navy in the Philippines to date. There will be a closing chapter upon the new ships now in progress of construction. The chief feature of this volume will, of course, be its presentation of the authoritative naval history of the war with Spain.

* * *

The late David A. Wells left behind him a last great work which will take rank as one of the most important of American contributions to economics. The larger part of his *Principles of Taxation* had already appeared in Appletons' Popular Science Monthly, so that the work had the benefit of the author's revision for the press. The consequence of this book need not be emphasized.

* * *

The reminiscences of the late John Sartain include his early life in London. Various distinguished people, interesting historical happenings, quaint features of

London schools, phases of artistic life, and old buildings since destroyed are pictured in a most entertaining fashion. When Mr. Sartain came to the United States his association included meetings with Irving and others in New York, and a close intercourse with Edgar Allan Poe, which has yielded many personal recollections of a most interesting and illuminating character. Mr. Sartain was singularly fortunate in his acquaintances and associates, and his entertaining book, with its wealth of personal, literary, and artistic anecdotes, will be certain of generous appreciation.

* * *

Dr. A. Conan Doyle.

The new novel by Dr. Doyle, which has been awaited with so much interest, is entitled *A Duet, with an Occasional Chorus*. The story is one in which the author has felt a peculiar interest. The scene is laid in London, and the story is one of the present time. The scene opens where the conventional novel ends—with a marriage, and another point of difference from the usual novel is that the marriage turns out happily, notwithstanding the varied experiences of hero and heroine. Dr. Doyle shows a new phase of his fine talent in this book. As a story of wedded love it has an idyllic character which will appeal to every reader not devoid of healthy sentiment. As an adroit interpretation of a true philosophy of wedded life the story contains illustrations and pithy sayings which will enlist the interest of women and men alike. As a story pure and simple the play of motives, contrast of characters, unexpected incidents, delightful humor, and sustained interest will be certain to increase the large company of the author's friends. Probably American readers will feel a stronger interest than their English cousins in the vivid glimpses which the author contrives to introduce of historic scenes in Westminster Abbey, of St. Olaf's Church, the burial place of Pepys, and of the home of Thomas Carlyle. In a literary way it will be of interest to every one to note that the author of "The White Company" and the creator of "Sherlock Holmes" shows so light, sympathetic, and assured a touch in this charming picture of wedded life. It should be noted that the author has sacrificed his serial rights for the sake of presenting his complete story to the public for the first time in book form.

* * *

Miss Ellen Thornycroft Fowler.

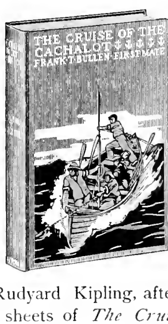
Miss Ellen Thornycroft Fowler is the eldest daughter of the Right Honorable Sir Henry Fowler, G. C. S. I., M. P., ex-Secretary of State for India, by Ellen (Imperial Order of the Crown of India), daughter of the late G. B. Thornycroft, Esq., of Chapel House, Wolverhampton and Hadley Park, Salop. Miss Fowler has amused herself by writing stories and verses ever since she can remember. In 1891 she published her first book, "Verses Grave and Gay," which was followed, in 1895, by "Verses Wise and Otherwise"; in 1897, by "Cupid's

Garden"; and in 1898, by "Concerning Isabel Carnaby," her first regular novel. She has one sister and one brother. Her sister, Edith Henrietta Fowler, is the author of two very popular children's books, "The Young Pretenders" and "The Professor's Children." Miss Fowler resides with her father at Woodthorne, Wolverhampton, his country seat. He has a London house as well.

* * *

"Concerning Isabel Carnaby" is to be followed shortly by Miss Fowler's second novel, which is entitled *A Double Thread*. The brilliancy of her first novel is accentuated in the new book, which, moreover, will be found to represent even more distinctly the story-telling purpose. There is a peculiar plot, with certain most unexpected developments, and the author's ingenuity in construction is no less apparent than the wit, incisiveness, and intense modernity of her dialogue. The new novel deals for the most part with English country-house life.

* * *



Mr. Rudyard Kipling, after reading advance sheets of *The Cruise of the Cachalot*, by F. T. Bullen, wrote the author as follows:

"*Dear Mr. Bullen: It is immense—there is no other word. I've never read anything that equals it in its deep-sea wonder and mystery; nor do I think that any book before has so completely covered the whole business of whale-fishing, and at the same time given such real and new sea pictures. You have thrown away material enough to make five books, and I congratulate you most heartily. It's a new world that you've opened the door to.*

"*Very sincerely,*

"*RUDYARD KIPLING.*

"ROTTINGDEAN, *November* 22, 1898."

FRANK T. BULLEN.

The success which Mr. Frank T. Bullen has won by the force and vividness of his pictures of seafaring life imparts a special interest to the announcement of his forthcoming book, *Idylls of the Sea*. This book sketches varied phases of the life and experiences of those who go down to the sea in ships. It is not confined to the whaler's exploits, but includes the things which are seen and the adventures which are undergone by all manner of men upon the sea.

* * *

MISS LILY DOUGALL.

The Mormon Prophet, by Miss Lily Dougall, the most important of this author's books, is a work which will attract wide attention. This remarkable historical novel depicts the actual beginnings of Mormonism, the character of the first "revelations" and of those who accepted them, and the extraordinary experiences and persecutions of the early members of the sect. Merely as a story of strange happenings and adventures this novel would enlist the interest of readers, but it has also as really its chief reason for being, the great interest attaching to its portraiture of the character of Joseph Smith. In these pages the peculiar temperament of the "Prophet," the founder of the sect, is placed before readers in a manner which will open to them an unknown chapter in our history. The author has studied his character in the light given by modern psychological research, and the results will probably be accepted as a true interpretation of an extraordinary character. The story shows what Mormonism was at the outset, and traces the changes which showed themselves clearly at Nauvoo City, where polygamy, which was nowhere present in the original creed of the sect, is said to have had its origin. At the present time an intimate interest will be felt in this vivid picture of the Mormon Prophet's origin and career, the steadfastness of his followers throughout ignominy and peril, and the strange modifications introduced in their beliefs in the days of prosperity and material temptation.

* * *

Since Miss Dougall's strong novel sets forth the original creed of the Mormons and shows the changes in their beliefs, its appearance at a time when so much interest is felt in the Roberts case will be welcomed by thoughtful readers. In regard to the case of Brigham H. Roberts, recently elected to Congress in Utah, whose admission to Congress has been the subject of many protests, a correspondent of the "New York Evening Post" has written as follows:

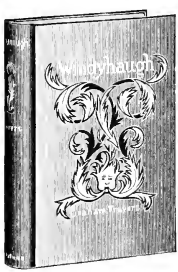
"Without attempting to fathom the intentions of the leaders of the Mormon Church, who have a commendable habit of keeping their own counsel, the election of Mr. Roberts certainly demonstrates the fact that a man can be elected Representative from Utah who is living in polygamy, in defiance of the prohibitions of his church and the laws of his State, and who admits that the pledges under which statehood was granted to Utah were meant to be kept only so far as suited the convenience of the men who made them. Briefly, it proves that a majority of the people of Utah see no reason why a polygamist and a political confidence man should not represent them in Congress. . . . The leading question discussed in the campaign was whether it would be wise, proper, and politic to send Mr. Roberts down to Washington, with his polygamous record. His acceptance or rejection by the Fifty-sixth Congress will simply show the Mormons how far they can safely go. The church is still teaching the essential righteousness of polygamy. Young men, who do not under the new revelation contract plural marriages, continue to lead to the Temple young women who are there sealed to them for the world to come, a form of engagement which does not become effective until death. Polygamy, according to the revelation, is not to be encouraged in this world, but it is the regular thing in the next. The old polygamists continued to live with their complete families, like Representative-elect Roberts, and among the younger generation, who are supposed to respect the new revelation, there are many lapses from the rule of monogamous marriages."

* * *

The lack of a comprehensive book for travelers, investors, and others, devoted entirely to Puerto Rico, will insure a welcome for *Puerto Rico and its Resources*, by Frederick A. Ober, the well-known traveler in the West Indies, which is published by D. Appleton and Company. The aim has been to produce a work that will answer all questions likely to arise in connection with the acquisition and occupation of this new tropical possession of ours, and to this end Mr. Ober has availed himself of every opportunity of adding to his stock of information acquired during the past eighteen years. His book is not a sketch for the casual visitor, or impressions of a traveler in search of the picturesque, but it is a comprehensive, informing, and interesting account of the people, land, and products, with the full explanations of the actual conditions and opportunities which are needed by visitors and intending investors. The Hon. Henry Cabot Lodge has written the author:

"You have brought together in a small space an immense amount of most valuable information, which it is very important to have within the reach of the American people at this time."

* * *



The new novel, *Windyhaugh*, by Graham Travers, author of "Mona Maclean," is attracting much attention both in this country and in England. It is the story of a modern woman, but a story which will be read by men and women alike. The heroine "carved no statue, painted no picture—she did not even write a book; but when all these things have been excluded, there remains that little art of living which has been open in all ages alike to the wise and the simple." Of this novel "Blackwood's Magazine" has recently said:

"'Windyhaugh' shows an infinitely more mature skill and more subtle humor than 'Mona Maclean' and a profounder insight into life. The psychology in Dr. Todd's remarkable book is all of the right kind; and there is not in English fiction a more careful and penetrating analysis of the evolution of a woman's mind than is given in Wilhelmina Galbraith; but 'Windyhaugh' is not a book in which there is only one 'star' and a crowd of 'supers.' Every character is limned with a conscientious care that bespeaks the true artist, and the analytical interest of the novel is rigorously kept in its proper place and is only one element in a delightful story. It is a supremely interesting and wholesome book, and in an age when excellence of technique has reached a remarkable level, 'Windyhaugh' compels admiration for its brilliancy of style. Dr. Todd paints on a large canvas, but she has a true sense of proportion."

* * *

Hall Caine.

In his preface to the revised edition of *The Scapegoat*, recently published by Messrs. D. Appleton and Company, Mr. Hall Caine says: "This book in its present form is new to American readers, although a book under the same title, telling practically the same story, was published in America seven years ago, That was just after the passing of the Copyright Act, and the effort to meet the conditions of the new law seemed to require that the romance should be published in what I knew was an immature and wholly unsatisfactory form. This was the form in which it was being published serially in English and American journals, without the revision usually considered necessary for any piece of writing before its appearance as a book, and especially desirable in the case of the present work. . . . When health and opportunity allowed, I did my best to make the story worthy of the reception it had received by an effort to lift its literary execution to the level of its artistic motive. With these alterations and with amendments made very recently I am now offering *The Scapegoat* to American readers practically, I think, as a new book, certainly as a book which is in great part new."

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Edward Noyes Westcott,
Author of "David Harum."

In response to numerous inquiries concerning the personality of the late Edward Noyes Westcott, the author of "David Harum," Mr. Forbes Heermans, who wrote the preface for the novel and who was intimately acquainted with the author, was invited by the editor of "The New York Times's Saturday Review" to prepare a brief sketch of Mr. Westcott. He responded as follows:

"The interest which is always felt in the life and personality of the writer of a successful book originates, it would seem, in the sympathetic and kindly desire of his readers for a more intimate acquaintance with him than they can obtain through his fictitious characters. This is surely not mere curiosity, but rather an expression of genuine friendliness, and for that reason it is one that may be unhesitatingly gratified. Usually the manner of preparing such a biography as these conditions require may be left, in some degree, to the approval of the subject of it, but in the present case that is not possible, for the author of 'David Harum' died six months before his book was published. Therefore, what is here set down concerning him must err rather on the side of reticence than of frankness.

"Edward Noyes Westcott was born in Syracuse, N. Y., September 3, 1847, and died there of consumption, March 31, 1898. His father, Dr. Amos Westcott, was one of the conspicuous citizens of that city a generation or more ago, and during part of the civil war was its mayor. Edward received the education that was given to most youths of that day and locality, which ended with the high school, and then, instead of going to college, as he greatly desired to do, he found it necessary to enter upon a business career. Although Nature had endowed him with the true artistic temperament, keenly sensitive to all impressions, both subjective and objective, he nevertheless became a bank clerk, an occupation that was, during the time of the war and the decade following it, one of deadly monotony, occasionally varied by days of terrific storm and stress. But here as elsewhere he did his work thoroughly and, when the chances offered, as brilliantly as if it had been his true vocation. In this way he passed the active years of his life; first as bank clerk, teller, and cashier; then as head of the firm of Westcott & Abbott, bankers and brokers, and finally as registrar and financial expert of the Syracuse Water Commission.

"In personal appearance Mr. Westcott was tall and slender, of a graceful figure; and his handsome, intellectual face would, upon occasions, light up with a smile of cordial friendship that was extremely attractive and magnetic. He was married to Jane Dows, a niece of the late David Dows, of New York. Mrs. Westcott died in 1890, leaving three children, Harold, Violet, and Philip, the last two being still under age.

"It was in music, perhaps, that Mr. Westcott achieved his greatest non-commercial success, for in this art he had received most excellent professional instruction, and his superb barytone voice gave him a suitable instrument for adequate expression. In this field, as in that of banking, the readers of 'David Harum' benefit by the author's experiences; for in describing the trials of a church choir director he has undoubtedly related some of his own. He possessed, moreover, a considerable talent for musical composition, and many songs, of which he wrote not only the words and air, but the harmony as well, have been published and sung by those who never knew the composer's name.

"Although during many years of his life Mr. Westcott made frequent use of his pen for other purposes than figuring, he seldom wrote for publication, and never then except upon matters of current financial and political interest. Some of the pamphlets which have been issued by the Reform Club of New York were prepared either wholly or in part by him, but it was not until his health entirely broke down, and he saw the coming of the one Inevitable Thing, that he began 'David Harum.' At first he wrote to occupy his hands and mind. At length the story took shape and distinction, the work grew easier and pleasanter, and presently the author found himself taking genuine delight in it. 'I'm enjoying David immensely,' he wrote. 'I never have to think what he is going to do or say next; he is always ready, long before it is his turn.' He had been seeking his vocation all his life, and now, just as the clock was about to strike the last hour, he found it. Surely, this is one of life's little ironies."

* * *

The *History of Japanese Literature*, which Mr. W. G. Aston has written as the sixth volume in the Literatures of the World Series that Mr. Gosse is editing for Messrs. D. Appleton and Company, differs from those which have preceded it in the fact that two thirds of it is translation and only one third narrative or criticism. This, it is believed, will greatly add to the pleasure and amusement of the general reader. The Japanese have cultivated a voluminous literature for more than twelve centuries, but forty years ago no English-speaking man had read one page of a Japanese book. Even now no history of Japanese prose and poetry exists in any European language, and Mr. Aston, whose life has been given to this subject, has a free field. It is believed that the richness and variety of the ancient prose literature of Japan will astonish American readers. One point that is very curious is the commanding place which women have taken in Japan since the most ancient times. The classical writers of the eleventh century were all women, and Mr. Aston's analysis of and quotations from their works will be read with great entertainment. This is certainly one of the most remote excursions into literary history which has been made for a long time. Mr. Aston brings his narrative up to the very latest writers, who are now taking advantage of the Japanese copyright law in Tokio and in Yokohama.

W. G. Aston.

Dr. William Elliot Griffis, of Cornell University, has very kindly contributed the following brilliant and informing sketch of his friend Dr. W. G. Aston, author of *Japanese Literature*:

"The wonderful city of Tokio looks very differently to-day from that morning, thirty-five years ago, when Mr. Aston first saw it. In this penultimate year of the century there are chimneys by the hundreds, and great tubes of brick and iron vomit out smoke to offend skies. Modern buildings abound. The staring freshness of paint, the noise of the horsecar, the unæsthetic telegraph pole and wire, the spectacled policeman, and the noisy newspaper boy all show contrast to the chimneyless level of wooden houses in the early '60s. Gone are the tycoons, daimios, spectacular processions, and the oddities—now seeming antediluvian when they come forth in the commemorative festival, but then appropriate parts of a great whole.

"In that wonderful city, then fenced off as to its interior by wooden palings into wards, with guardhouses and appropriate rakes and long-poled balls or hooks for keeping unruly sword-wearers at bay, came English-speaking foreigners to live. Among them were two young men fresh from the university, who, taking rooms in the heart of the daimios' quarter, began the study of Japanese. No English-speaking person at the time could read Japanese books, though some had already made a beginning. Messrs Aston and Satow (the latter now British Minister in Tokio) collected native books and manuscripts. Engaging the best teachers, they commenced that pathway into the unknown region of Japanese literature in which many others have since followed, though none has gone far ahead of the pioneers. It is true, however, that Prof. B. H. Chamberlain may worthily be added to make a trio. Satow excelled as a historian; Chamberlain is a master in Japanese belles-lettres; but Aston is probably first in insight into the language and its history, and in being able, by profound knowledge and easy familiarity and cool and clear judgment, to show the whole course of Japanese thought and literary expression. He is not only the author of grammars of the written and spoken languages, but the translator of the older and probably the more valuable of the two books which lie at the foundation of Japanese history and literature—the 'Nihongi' or 'Chronicles of Japan,' from the earliest times to A. D. 1697. There may possibly be those who can write more entertainingly upon the literature of Japan; it is quite certain that none can appraise it with a more truly judicial mind than Mr. Aston.

"Let us look at the life of this scholar and man of letters. He is the kind of man whom the United States will need in great numbers during the next few generations, for with our Pacific and Asiatic possessions we shall be in want of language-tamers. Mr. Aston was born in 1841, near Londonderry, and educated at Queens College, Belfast, between 1859 and 1863. One of his professors was the late Dr. James McCosh, so well known among us as president of Princeton University. He was appointed student-interpreter in Japan in 1864. After his preliminary work in Tokio he went to Nagasaki as interpreter to the British consulate. He brought out his first sketch of Japanese grammar in 1868. Returning to his native country he was so fortunate as to marry a wife who has been his devoted helper and guardian during a decade or more of invalidism. While at home he issued his 'Grammar of the Japanese Written Language,' with a chrestomathy.

"Returning to Japan he was successively acting consul at Kobe, consul at Nagasaki, and then consul-general for Korea. The latter appointment delighted all those interested in the (once) Hermit Kingdom, for, knowing Mr. Aston's historical, literary, and linguistic tastes and powers, they expected something of value from him that would throw light upon Japanese origins and claims. Nor were they disappointed. Mr. Aston soon mastered Korean, and showed how closely the Koreans and Japanese were associated in mind and history. In the awful riot of 1884—one of the almost inevitable accompaniments of sudden change from the ancient to the modern *régime*—Mr. Aston took cold from night exposure, and from this time his health was shattered.

"He was made secretary of the British legation in Tokio, but was retired on a pension, and returning home lived for several years at Seton, in Devonshire, where, through the care of his devoted wife, though 'dying by inches'—as one of his old friends told me—he has been able to translate and publish the 'Nihongi,' a work of prodigious scholarship and of vast value to the student of Japanese origin. Queens University in Ireland gave him the degree of A. M. in 1863, and subsequently the title of Doctor of Literature, *honoris causa*.

* * *

Messrs. D. Appleton and Company wish to call special attention to the new editions of Mr. F. M. Chapman's *Bird-Life* which are now ready. This successful book is presented in an octavo edition with colored plates, a library edition with black and white plates, a teachers' edition, and a teachers' manual containing the regular text, and intended to accompany portfolios of colored plates.

* * *

It is proper at this time to emphasize the excellent volume upon *Spain* which Mr. Frederick A. Ober has prepared for Appletons' History for Young Readers Series. The leading events of Spain's history, with special reference to her American colonies, the rise and fall of the empire, the causes and effects of the loss of her colonial power from the earliest period to the close of the late war, are presented in a way to interest the young reader, and give him a clear view of the romantic career and inglorious decline of the Spanish empire.

* * *

Dr. W. T. Harris,
Editor International Education Series.

The important new volume, *Letters to a Mother*, by Miss Susan E. Blow, is a valuable addition to the International Education Series, edited by the Hon. W. T. Harris, U. S. Commissioner of Education.

The object of this book is to explain in language addressed to the general public the philosophy of Froebel. Its author finds it necessary for this purpose to take up the most important doctrines one after the other as they were developed in the "Mutter und Kose Lieder," and show their equivalents in the different systems of thought that prevailed. In some cases these systems are in harmony with Froebel, and in other cases there is profound disagreement. It is well for all students of the kindergarten to deepen their knowledge of his principles by seeing their ultimate consequences and understanding how they apply to practical questions in the instruction of the young. The teacher ought to be able to understand things in their causes and reasons, and not rely too much upon mere authority. The importance of this will be readily understood by those who have seen in recent years the unprofitable experiments made by kindergartners who have only partially understood Froebel, and who have been easily caught by some plausible doctrine brought forward as an improvement, but which is really at variance with the true theory of the kindergarten as well as with that of all sound pedagogy.

The readers of the discussions in this book will readily concede that the exposition of the results of the theory of the kindergarten, and also the defense of its practice as against systems that conflict with it, are presented with a clearness and force new in the literature of the subject. In this respect, as well as in many others, this book is most timely.

* * *

Uncle Sam's Soldiers is the title of a story for boys just issued by D. Appleton and Company. It is a companion story to "Uncle Sam's Secrets" issued by this firm in 1897, with later editions in 1898, and is by the same author, Mr. O. P. Austin, the present Chief of the Bureau of Statistics, Treasury Department. The story, which purports to be the experience of two boys verging upon manhood who served with the armies in Cuba, Puerto Rico, and the Philippines, gives largely in conversational form the facts regarding modern military methods in a way which can not fail to interest the younger generation or those whose experiences in the civil war would lead them to value some account of the developments in war methods since that time.

* * *

Our Navy in Time of War, the new volume in Appletons' Home-Reading Series, by Franklin Matthews, makes its appearance opportunely. The essential technical points of our navy's achievements have been emphasized and exploited in this book, which is designed to interest the young reader in historical research. No more stirring chapters in our country's history could be selected than are contained in the story of the navy from Paul Jones to Dewey. This book should be in the library of every boy in the country.

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