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WILLIAM JAY YOUMANS

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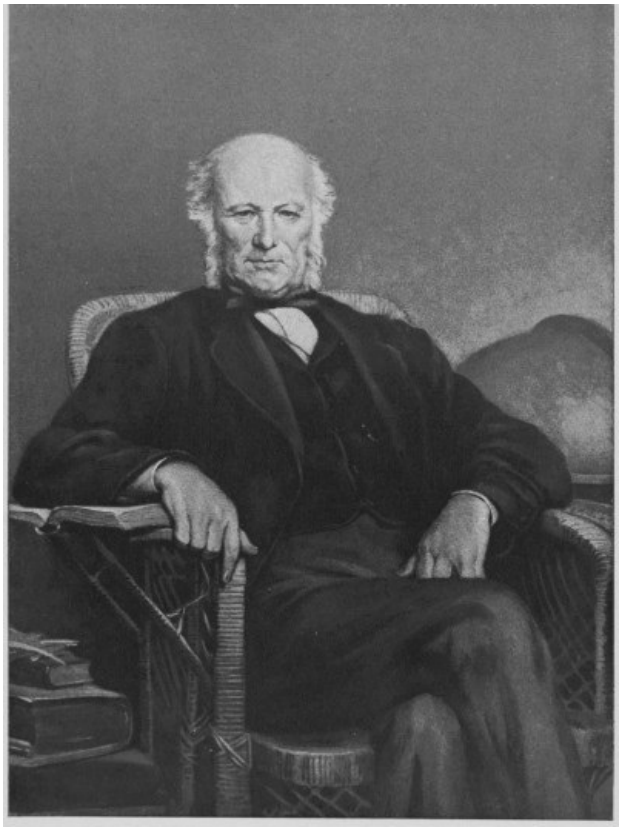


WILLIAM PENGELLY.

APPLETONS' POPULAR SCIENCE MONTHLY.

FEBRUARY, 1899.

ALASKA AND THE KLONDIKE.

A JOURNEY TO THE NEW ELDORADO.

By ANGELO HEILPRIN,

PROFESSOR OF GEOLOGY AT THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, FELLOW OF THE ROYAL GEOGRAPHICAL SOCIETY OF LONDON.

I.—IN BY THE WHITE PASS AND OUT BY THE CHILKOOT.

Hardly two years ago the names Dawson and Klondike were entirely unknown to the outside world, and geographers were as ignorant of their existence as was at that time the less learned laity. To-day it may be questioned if any two localities of foreign and uncivilized lands are as well known, by name at least, as these that mark the approach to the arctic realm in the northwest of the American continent. One of those periodic movements in the history of peoples which mark epochs in the progress of the world, and have their source in a sudden or unlooked-for discovery, directed attention to this new quarter of the globe, and to it stream and will continue to stream thousands of the world's inhabitants. Probably not less than from thirty-five thousand to forty thousand people, possibly even considerably more, have in the short period following the discovery of gold in the Klondike region already passed to or beyond the portals of what has not inaptly been designated the New Eldorado. To some of these a fortune has been born; to many more a hope has been shattered in disappointment; and to still more the arbiter of fate, whether for good or for bad, has for a while withheld the issue.

In its simplest geographical setting Dawson, this Mecca of the north, is a settlement of the Northwest Territory of Canada, situated at a point thirteen hundred miles as the crow flies northwest of Seattle. It is close to, if not quite on, the Arctic Circle, and it lies the better part of three hundred miles nearer to the pole than does St. Petersburg in Russia. By its side one of the mighty rivers of the globe hurries its course to the ocean, but not too swiftly to permit of sixteen hundred miles of its lower waters being navigated by craft of the size of nearly the largest of the Mississippi steamers, and five hundred miles above by craft of about half this size. In its own particular world, the longest day of the year drawls itself out to twenty-two hours of sunlight, while the shortest contracts to the same length of sun absence. [Pg 2]

During the warmer days of summer the heat feels almost tropical; the winter cold is, on the other hand, of almost the extreme Siberian rigor. Yet a beautiful vegetation smiles not only over the valleys, but on the hilltops, the birds gambol in the thickets, and the tiny mosquito, either here or near by, pipes out its daily sustenance to the wrath of man. The hungry forest stretches out its gnarled and ragged arms for still another hundred or even three hundred miles farther to the north.

Up to within a few years the white man was a stranger in the land, and the Indian roamed the woods and pastures as still do the moose and caribou. To-day this has largely changed. The banks of the once silent river now give out the hum of the sawmill, the click of the hammer, and the blast of the time-whistle, commanding either to rest or to work. A busy front of humanity has settled where formerly the grizzly bear lapped the stranded salmon from the shore, and where at a still earlier period—although perhaps not easily associated with the history of man—the mammoth, the musk ox, and the bison were masters of the land. The red man is still there in lingering numbers, but his spirit is no longer that which dominates, and his courage not that of the untutored savage.

The modern history of Dawson begins with about the middle of 1896, shortly after the "public" discovery of gold in the Klondike tract. Three or four months previous there was hardly a habitation, whether tent or of logs, to deface the landscape, and the voice of animate Nature was hushed only in the sound of many waters. At the close of the past year, as nearly as estimate can make it, there were probably not less than from fourteen thousand to fifteen thousand men, women, and children, settled on the strip of land that borders the Yukon, both as lowland and highland, for about two miles of its course near the confluence of the Klondike. Many of these have located for a permanence, others only to give way to successors more fortunate than themselves. Some of the richest claims of the Bonanza, now a famed gold creek of the world, are [Pg 3] located hardly twelve miles distant, and the wealth of the Eldorado is discharged within a radius of less than twenty miles. Over the mountains that closely limit the head springs of Bonanza and Eldorado, Hunker, Dominion, and Sulphur Creeks thread their own valleys of gold in deep hollows of beautiful woodland—fascinating even to-day, but already badly scarred by the work that man has so assiduously pressed in the region. This is the Klondike, a land full of promise and of equal disappointment, brought to public notice in the early part of 1897, when intelligence was received by the outside world regarding the first important gold location on Bonanza Creek in [Pg 4] August of the year previous.

Looking down the Lynn Canal—Skaguay River, with Skaguay on the Left.

On the 24th of July of the past year I found myself on the principal thoroughfare of Skaguay, the ubiquitous Broadway, contemplating a journey to the new north. The route of travel had been determined for me in part by the non-arrival at Seattle of the expected steamers from the mouth of the Yukon River, and by that woeful lack of knowledge regarding "conditions" which so frequently distinguishes steamship companies. It was to be, therefore, the overland route, and from Skaguay it was merely the alternative between the White Pass and the Chilkoot Pass or Dyea trails. The two start from points barely four miles apart, cross their summits at very nearly the same distance from one another, and virtually terminate at the same body of inland water, Lake Lindeman, the navigable head of the great Yukon River. A more than generous supply of summer heat gave little warning of that bleak and severe interior with which the world had been made so well familiar during the last twelvemonth, and from which we were barely six hundred miles distant; nor did the character of the surroundings betray much of an approach to the Arctic Circle. Mountains of aspiring elevations, six thousand to seven thousand feet, most symmetrically separated off into pinnacles and knobs, and supporting here and there enough of snow to form goodly glaciers, look down upon the narrow trough which to-day is the valley of the Skaguay River. At the foot of this ancient fiord lies the boom town of Skaguay. Charming forests, except where the hand of man has leveled the work of Nature to suit the requirements of a constructing

railway, yet clothe the mountain slopes and fill in the gap that lies between them, shadowing the dense herbage and moss which almost everywhere form an exquisite carpeting to the underlying rock. The ear may catch the strains of a few mosquitoes, or the mellow notes of the robin or thrush, but rising far above these in the majesty of tone and accent is the swish of the tumbling cataracts which bring the landscape of Norway to America. Man, it is claimed, is much the same the world over; but there is a limitation. The second habitation of white man in Skaguay was established less than a year before my visit; yet at that time, presumably to meet the demands of a resident population of nearly five thousand, and of the wandering hordes pressing to the interior, the destructive hand of the advertiser had already inscribed on the walls of rock, in characters twenty feet or more in height, and sufficiently elevated to make them nearly the most conspicuous elements of the landscape, the glories of cigars, the value of mental and physical specifics, and of other abominations which were contrived to fatten the Yankee pocket.

[Pg 5]

A Summer Day on the Skaguay.

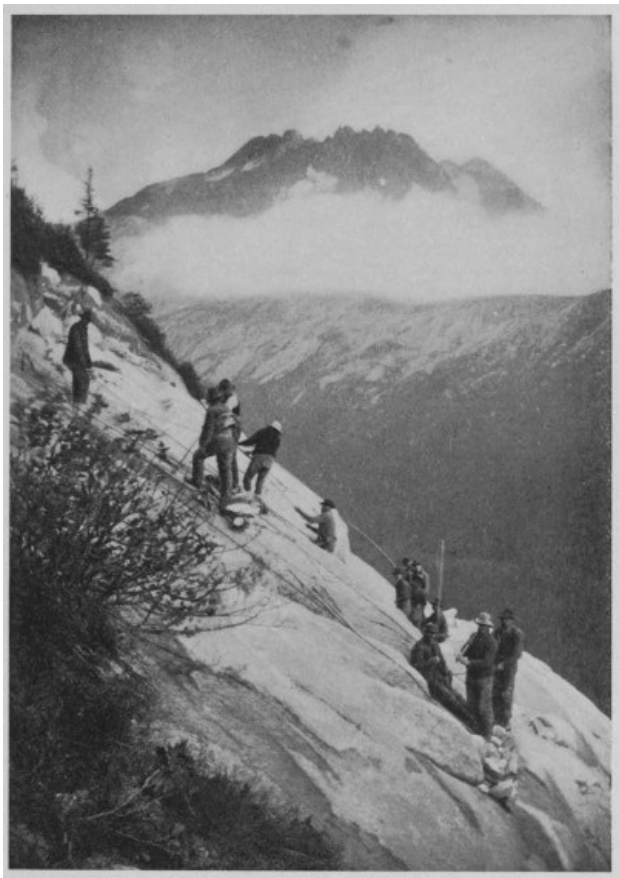
Had it not been for the kindly advice of one who had just returned from the Klondike, and who claimed to have crossed both passes fifty times, I should almost unhesitatingly have taken the White Pass trail; but the representation that beyond the summit the mud would be neck-deep and virtually impenetrable for a distance of twenty miles or more, cast the decision in favor of the Chilkoot. The fortunate or unfortunate circumstance that a billowy sea made a landing of passengers at Dyea impossible on that day threw me back upon my first resource, and about two hours before midday of the 30th I was mounted on a horse following out the Skaguay trail. By seven o'clock in the evening of the following day I had reached Lake Lindeman, and about a half hour later Lake Bennett, the starting point of the lines of Upper Yukon steamers which had just recently been established. We had made the forty miles of the dreaded White Pass trail without serious hindrance or delay, up over the summit of 2,860 feet elevation, and down over a course which was depicted in colors of hardship that would have done more truthful service in describing a pass in the Himalayas. There was no mud, not a trace of snow or ice except on the mountain declivities, and had it not been for a horse that was both stiff and lame, and required my attention as pedestrian to an extent that had not been bargained for, the journey would have been an exceptionally delightful one.

[Pg 6]

Coming down the White Pass—Winter.

It is true that an unfortunate fall at one time almost deprived me of my animal, but the service of tackle soon put him to rights and to his feet, and but few blood marks were left on the rocks to tell of the struggle. The most disagreeable incident of the journey was a dense and shifting fog, which so blocked out the landscape of early evening as to necessitate "feeling" the brokenness of a glaciated country in order to ascertain wherein lay the trail. But beyond this there was a perpetual delight in the landscape—in the narrow rocky defile, the bursting torrent, the open meadows, with their carpet of green and variegated with fireweed, gentian, rose, and forget-me-not, which more than compensated for the little vexations that allied themselves with the journey.

It is not often that the selection of a route of travel is determined by the odorous or malodorous qualities which appertain thereto. Such a case was, however, presented here. It was not the depth of mud alone which was to deter one from essaying the White Pass route; sturdy pioneers who had toiled long and hard in opening up one or more new regions, laid emphasis upon the stench of decaying horse-flesh as a factor of first consideration in the choice of route. So far as stench and decaying horse-flesh were concerned, they were in strong evidence. The Desert of Sahara, with its lines of skeletons, can boast of no such exhibition of carcasses. Long before Bennett was reached I had taken count of more than a thousand unfortunates whose bodies now made part of the trail; frequently we were obliged to pass directly over these ghastly figures of hide, and sometimes, indeed, broke into them. Men whose veracity need not be questioned assured me that what I saw was in no way the full picture of the "life" of the trail; the carcasses of that time were less than one third of the full number which in April and May gave grim character to the route to the new Eldorado. Equally spread out, this number would mean one [Pg 7] dead animal for every sixty feet of distance! The poor beasts succumbed not so much to the hardships of the trail as to the inhuman treatment, or lack of care and assistance, which they received on the part of their owners. Once out of the line of the mad rush, perhaps unable to extricate themselves from the holding meshes of soft snow and of quagmires, they were allowed to remain where they were, a food offering to the army of carrion eaters which were hovering [Pg 8] about, only too certain of the meal which was being prepared for them. Oftentimes pack saddles, and sometimes even the packs, were allowed to remain with the struggling or sunken animal—such was the mad race which the greed of gold inspired.



Cutting Grade for the Pacific and Arctic Railway—Tunnel Mountain, White Pass Route.

On October 9th I was again at Bennett, this time returning from my journey into the interior, and full of experience of what steam navigation on the upper six hundred miles of Yukon waters might mean. There was now a change in the sentiment regarding the quality of the two passes. The Pacific and Arctic Railway, the pioneer of Alaska steam railways, was operating twelve miles of track, and had thus materially reduced the "hardships" of the Skaguay trail; the Chilkoot, on the other hand, was represented to be in the worst of mood, and prepared to put the passing traveler into the same condition. It was more than late in the season, but the winter's blasts had been stayed off by a full month, and there were still no signs of their coming. A little ice had begun to form along the river's margin and over sheltered pools, and an occasional cool night made demands for moderately warm clothing proper; but, on the whole, the temperature was mild and balmy, and to its influence responded a vegetation which in its full glory might easily have called to mind the region of the Juniata.

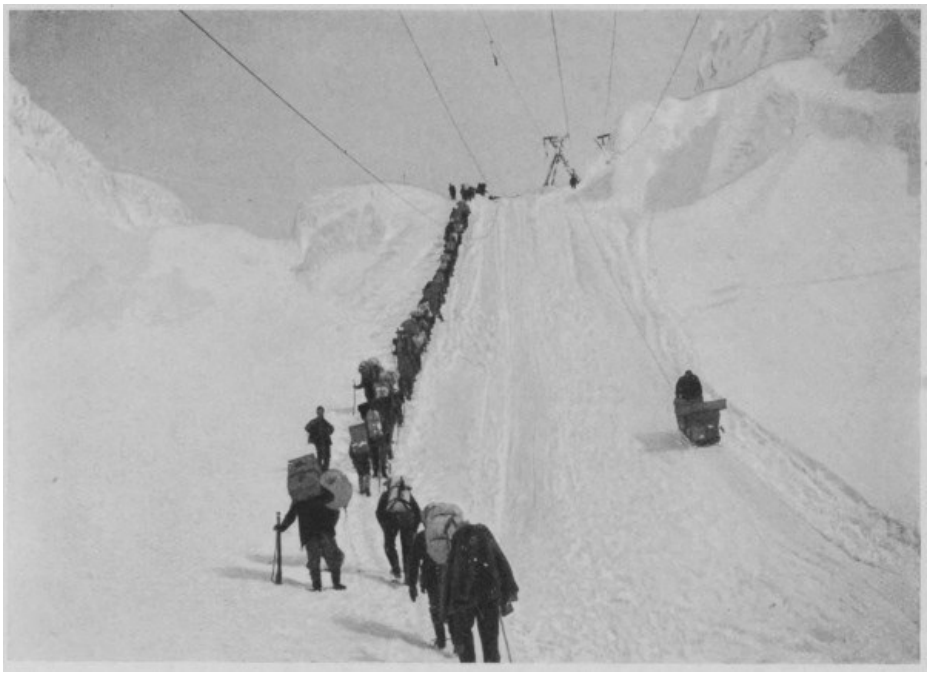
Although strongly warned against taking the Chilkoot Pass so late in the season, many of the outgoers, whose recollections of events in the early part of the year were still vividly fresh, and who could not be persuaded that the period of a few months had so effaced the conditions of the past as to permit a steam railway to enter for twelve miles into the region, chose it in preference to the White Pass. My own mind had been cast in the same direction; not, however, from a point of judicious preference, but merely because I was anxious to see for myself that which had become historic in the movement of 1898, and of instituting a direct comparison of the physical features and general characteristics of the two routes. With no serious hindrance, the journey from Bennett out was that of a full day only, and there was no particular reason to suspect that there would be delay. Snow had fallen on the summit and whitened all the higher points, but seemingly it hung in only a measurably thin crust, and with not enough to necessitate breaking a trail.

A crude steam ferry across Lake Lindeman cuts off about six miles from the first part of the trail, after which a rapidly rising path, sufficiently distinct to permit it to be easily followed, winds over

the rocks and among rock *débris* to Long Lake, situated at an elevation of some twenty-six hundred feet, where night shelter is found in a fairly comfortable tent. Up to this point we had encountered but little snow, and the condition of the trail was such as to allow of rapid travel. A [Pg 9] wise caution detained us here for the night, and the incoming of a solitary traveler warned us that a blizzard had struck the summit of the pass, and buried it beneath a heavy mantle of snow. Had we been a day earlier we might have crossed dry shod, a very exceptional condition at this time of the year, but now the possibilities of a struggle gravely presented themselves. A light frost of the night had fairly congealed the soil, but the lake did not carry enough surface ice to interfere with the progress of a scow, and we reached the farther end without difficulty. The two-mile portage to Crater Lake was largely a snow traverse, but an easy one; at this time, however, [Pg 10] it began to snow heavily, and the immediate prospect was anything but cheerful. A low fog hung over the waters, but not so low or so dense as to prevent us from occasionally catching glimpses of the rocks which projected with disagreeable frequency from an assumed bottomless pit or "crater." The ascent from Crater Lake to the summit, somewhat less than three hundred and fifty feet, was made in about half an hour, and then began the steep and sudden plunge which marks the southern declivity of this famous mountain pass. Some little caution was here required to keep a foothold, and a too sudden break might have led to an exhilarating, even if not anxiously sought after, glissade; but in truth, to any one only moderately practiced in mountaineering, even this steep face, which descends for a thousand feet or more from a summit elevation of thirty-four hundred feet, presents little difficulty and hardly more danger. What there is of a trail zigzags in wild and rapid courses over an almost illimitable mass of rock *débris*, at times within sheltered or confined hollows, but more generally on the open face of the declivity. This it is more particularly that carries to many a certain amount of fear in the making of the passage, but, with proper caution and the right kind of boots, nothing of danger need be apprehended.

Unfortunately for the enjoyment of the scenery of the pass, I could see but a modest part of it. Although snow was no longer falling, and the atmosphere had settled down to a condition of almost passive inactivity—much to the surprise, if not disappointment, of a few who had prophesied a stiff and biting wind the moment we passed the divide—heavy cloud banks hovered about the summits, and only at intervals did they afford glimpses of the majestic mountain peaks by which we were surrounded. Enough, however, could be seen to justify for the pass the claims of most imposing scenery, and its superiority in this respect over the White Pass. The temperature at the time of our crossing was a few degrees below freezing, perhaps 25° or 27° F., but our rapid walk brought on profuse perspiration, and it would have been a pleasure, if a sense of proper caution had permitted, to divest ourselves of mackinaws and travel in summer fashion. We made Sheep Camp, with its surroundings of beautiful woodland, shortly after noon, and Cañon City, which, as the terminus of a good coach road to Dyea, virtually marks the end or beginning of the Chilkoot trail, at two o'clock.

To a mountaineer or traveler of ordinary resource neither the White Pass nor the Chilkoot Pass will appear other than it actually is—i. e., a mountain pass, sufficiently rough and precipitous in places, and presenting no serious obstacle to the passage of man, woman, or child. True, I did not see them at their worst, but they were both represented to be frightfully bad even at the time of [Pg 11] my crossing. The seasonal effects, doubtless, do much to modify the character of the trails, and even local conditions must mold them to a very considerable extent. It is not difficult to conceive of miry spots along the White Pass trail, or of snow-swept areas on the Chilkoot, and there certainly must be times when both trails are in a measure or way impassable. All trails are, however, subject to modifications in character, and even the best is at times sufficiently bad. Trains of pack animals cross the White Pass both winter and summer, and, even with the great loss to their "forefathers," their testimony of steady work is a recommendation of the class of service in which they are engaged. A limited number of cattle and horses have also found their [Pg 12] way over the summit of the Chilkoot Pass—some crossing immediately after us—but the trail is too steep on the ocean side to fit it for animal service, although I strongly suspect that were the location in Mexico instead of in Alaska, there would be a goodly number of *caballeros* and *arrieros* to smile at the proposition of presented difficulties. Indian women seem to consider it no hardship to pack a fifty-pound sack of flour and more over the summit, and there are many men who do not hesitate to take double this load, and make several journeys during the same day. It is the load that kills, and it was, doubtless, this influence, united to a cruel method, which so strongly impressed the pioneers with the notion of extreme hardship. The most level and perfect road, to one carrying for miles a pack of from sixty to eighty pounds, soon begins to loom up a steep incline.



THE FINAL ASCENT TO CHILKOOT SUMMIT—WINTER.

Both the northern and southern slopes of the Chilkoot Pass are largely surfaced with shattered rocks, over which, with occasional deflections across more pleasant snow banks, a fairly well-defined trail mounts on either side to the summit. In its grim landscape effects, more particularly on the inner face, where a number of rock-bound tarns—Crater Lake, Long Lake, Deep Lake—afford a certain relief to the degree of desolation which the scene carries, it reminded me much of the famous Grimsel Pass, and here as well as there the modeling of the surface through glacial action was strongly in evidence. The vastly towering Alpine peaks were, however, wanting, and the glaciers that still appeared showed that they had long since passed their better days. The actual summit is trenched by a narrow rocky gap, roughly worn through walls of granite, and by it have passed the thousands who have pressed to the interior. There is no timber growth at or near this summit, nor is there soil sufficient to give support to an arboreal vegetation. Nearest to the top line a prostrate form of scrubby hemlock (*Tsuga Pattoniana*) alone makes pretense to being a tree, but below it of itself grows to majestic proportions, and about "Sheep Camp," with Menzie's spruce, a birch, and cottonwood (*Populus balsamifera*), forms part of the beautiful woodland, which with ever-increasing freshness descends to the lower levels.

Lest I be accused of too freely seeing the beauties of the northern landscape, I venture in my defense the following graphic description of the Dyea Valley from the pen of another traveler and geologist, Prof. Israel Russell: "In the valley of the Taiya the timber line is sharply drawn along the bordering cliffs at an elevation of about twenty-five hundred feet. Above that height the mountain sides are stern and rugged; below is a dense forest of gigantic hemlocks, festooned with long streamers of moss, which grows even more luxuriantly than on the oaks of Florida. The [Pg 13] ground beneath the trees and the fallen monarchs of the forest are densely covered with a soft, feathery carpet of mosses, lichens, and ferns of all possible tints of brown and green. The day I traversed this enchanted valley was bright and sunny in the upper regions, but the valley was filled with drifting vapors. At one minute nothing would be visible but the somber forest through which the white mist was hurrying; and the next the veil would be swept aside, revealing with startling distinctness the towering mountain spires, snowy pinnacles, and turquoise cliffs of ice [Pg 14] towering heavenward. These views through the cloud rifts seemed glimpses of another world. Below was a sea of surging branches that filled all the valley bottom and dashed high on the bordering cliffs. Much space could be occupied with descriptions of the magnificent scenery about Lynn Canal, and of the wonderful atmospheric effects to be seen there, but the poetry of travel is foreign to these pages, and must be left for more facile pens."

The Chilkoot Trail—Power House of the Aërial Tramway.

In its present condition the Chilkoot trail has the advantage over the Skaguay in its shorter length, the distance from Dyea to the head of Lake Lindeman, the virtual head of river navigation, being about twenty-four miles; from Skaguay to Bennett, along the usual White Pass trail, the distance is fully ten or twelve miles longer, although a cut-off by way of the summit lakes reduces the traverse considerably. At intervals along both routes fairly good accommodation can now be had. One condition of the Chilkoot Pass, and that a not altogether light one, places it during certain months at a disadvantage as compared with the White Pass. I refer to the dangers from avalanches. These are of the true Alpine type, having their source in the heavy beds of snow which cling with bare support to the steeply pitching mountain walls, in places along some of the narrowest parts of the pass. The appalling catastrophe of April, 1898, which caused the loss of sixty-three lives, and followed closely upon an earlier event of like nature, had its seat in the steep, rocky ledges of the east wall between Sheep Camp and the Scales. It is claimed that the Indians along the trail clearly foresaw the impending event, and announced it in unmistakable language, but their warnings were allowed to go unheeded. They themselves did not make the traverse on that day. The minor disaster of the following December (9th), when but six lives were sacrificed, took place on the steep declivity which faces Crater Lake, not far from the service house of the Chilkoot Pass Aërial Tramway Company. Here the mountain face is very precipitous and gives but insecure lodgment to the snow. The Indians carefully watch all natural signals and urge a rapid journey. However useful these trails may have been in the past, how well or how indifferently they may have met the wants of the pioneers of 1897 and 1898, they are destined before long to be thrown into that same obscurity which they held when the Indians and a few adventurous trappers and traders alone made use of them as avenues of communication between the inner and outer worlds. The advance of the iron horse is now an assured fact, and the Pacific and Arctic Railway, whose construction is engineered by some of the most experienced mechanical talent of Great Britain and America, will minister before many months not alone to the professional interlopers in the new land, but to hosts of [Pg 15] tourists as well. The road, which in reaching White Pass summit will have a maximum gradient of a little more than five per cent, is of narrow-gauge construction, solidly supported on dressed ties brought from the forests of Oregon. No terminal appears to have been as yet definitely determined upon, although the charter act recites Fort Selkirk on the Yukon, about one hundred and sixty miles above Dawson, as such. Operating as it now does sixteen miles or more of road, it is already an extensive freight carrier; but until its completion to Bennett or to some point close to a navigable part of the Yukon River, the Chilkoot Pass tramway, a remarkable construction [Pg 16] which crosses over the summit and deposits at Crater Lake, must continue to handle a large part of the business intended for the interior.

Summit of the Chilkoot Pass, with Impedimenta of Prospectors, April, 1898.

It is safe to say that the stirring scenes which were enacted on the passes during the winter of 1897-'98, when the impedimenta of travel and occupation were packed together in the manner of an army camp, will not be repeated again. The past history was a short one, and it gives way to one of greater promise.

> Note.—For most of the photographic illustrations the author is indebted to the work of Curtis, Barley, and E. A. Hegg; especially to the last-named gentleman, of Skaguay and Dawson, is he under obligations for permission to use several of the copyrighted views.

THE ORIGIN OF EUROPEAN CULTURE.[1]

By WILLIAM Z. RIPLEY, Ph. D.,

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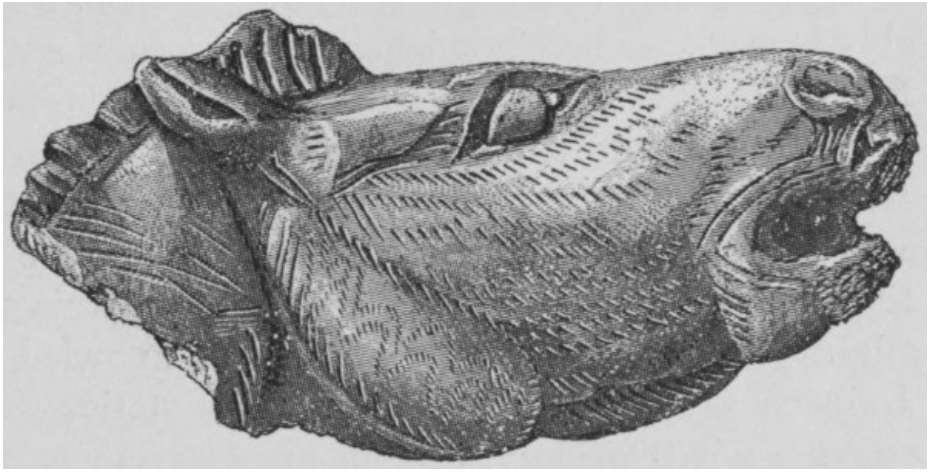
Prehistoric archæology is possessed of a distinct advantage over linguistics in the investigation of racial problems; for human remains are often discovered in connection with the implements, utensils, or trinkets by which the civilization of an extinct people is archæologically determined. To attempt even an outline of the cultural history of Europe would be obviously impossible in this place. It would fill a complete volume by itself alone. Furthermore, the short span of forty years since the inception of archæological science has not sufficed to produce complete unanimity of opinion among the leading authorities. Many important questions, especially concerning eastern Europe, are still awaiting settlement. All that we can hope to do is to describe what may be termed a few fixed points in European cultural history. This, as in our discussion of physical origins,[2] we shall attempt to do by means of definite propositions, concerning which there is now substantial agreement.

I. *In western and southern Europe an entirely indigenous culture gradually evolved during the later stone age. This was characterized by great technical advance in fashioning implements, carvings, and designs in stone, bone, ivory, and copper; by the construction of dolmens and habitations of stone; by pottery-making; and possibly even by a primitive system of writing.*

A marked reaction has taken place during the last ten years among archæologists respecting the course of cultural development in France. It was long believed that after the first crude attempts of the palæolithic epoch an extended *hiatus* ensued, followed by the sudden appearance of a more highly developed civilization, brought by an immigrant broad-headed race from the East. Two waves of invasion were described: the first bringing polished stone, a later one introducing bronze, cereals, agriculture, and the domestication of animals. Not even credit for the construction of the great stone dolmen tombs was granted to the natives in Gaul, for these were all ascribed to an invasion from the North. The undoubted submergence of the primitive long-headed population of France by a brachycephalic type from the East, to which we have already adverted, was held accountable for a radical advance in civilization. Even the existence of a bronze age was denied to this country, it being maintained that the introduction of bronze was retarded until both metals came in together from the Orient in the hands of the cultural deliverers of the land. The absence of a distinct bronze age was speedily disproved; but the view that France and western Europe were saved from barbarism only by a new race from the East

[Pg 17]

still held sway. It is represented by the classical school of G. de Mortillet, Bertrand, Topinard, and a host of minor disciples. The new school, holding that a steady and uninterrupted development of culture *in situ* was taking place, is represented notably by Reinach[3] in France and by Sergi[4] in Italy. Their proof of this seems to be unanswerable. Granting that it is easier to borrow culture than to evolve it, a proposition underlying the older view, it seems nevertheless that the West has too long been denied its rightful share in the history of European civilization.



Neolithic Ivory Carving. Mas d'Azil.
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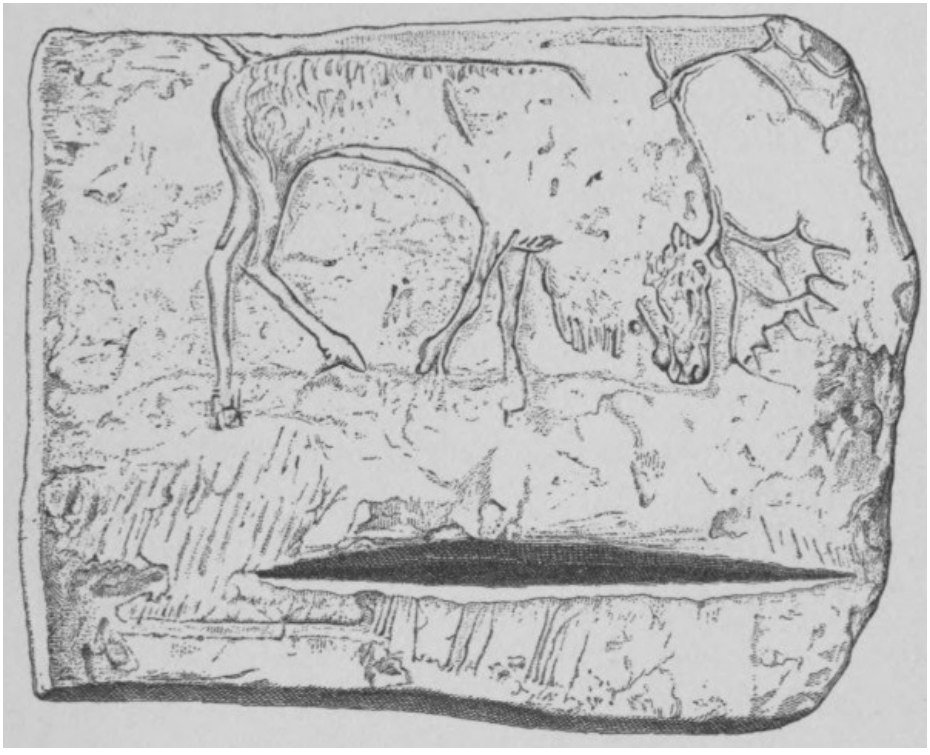
A notable advance in the line of culture entirely indigenous to southwestern Europe has been lately revealed through the interesting discoveries by Piette at the station of Brassempuoy and in the grotto of Mas d'Azil. Carvings in ivory, designs upon bone, evidence of a numerical system, of settled habitations, and, most important of all, of a domestication of the reindeer, of the horse, and the ox in the pure stone age have been found; and that, too, in the uttermost southwestern corner of Europe. In the lake dwellings of Switzerland, as also in Scandinavia, a knowledge of [Pg 18] agriculture, pottery, and the domestication of animals is evinced, likewise as a native discovery. From other quarters of the continent in the stone age comes similar testimony to a marked advance of man culturally. The justly celebrated carving of a reindeer from Thayngen, almost worthy of a modern craftsman, betrays no mean artistic ability. The man who drew it was far from being a savage, even if he knew no metals, and buried his dead instead of cremating them. The evidence as to early domestication of animals is perhaps the most startling. Carved horses' heads, with halters and rude bridles, have been surely identified by Piette and others.



Bone Carving. Thayngen. (After Bertrand, 1891.)

A system of writing seems also to have been invented in western Europe as far back as the stone age.[5] Letourneau and Bordier have advanced good evidence to this effect, although it is not yet incontestably proved. The Phœnicians were perhaps antedated in their noted invention by the dolmen builders, by the lake dwellers of the earliest times, and, according to Sergi, also by the people of the Villanova pre-Etruscan culture in Italy. In an earlier time still in the Po Valley, as far back as the stone-age *Terramare* period, pottery was made, and that, too, of a very decent sort. And all this time there is not the slightest evidence of contact with or knowledge of the East. As

Reinach says, in no dolmen, no lake station, no excavation of the stone age is there any trace of an Assyrian or Babylonian cylinder, or even an Egyptian amulet. Even the jade and nephrite found in western Europe from Switzerland to Norway, which has so long been regarded as evidence of early commerce with the East, he denies as proof of such contact. The case thus put may perhaps be over-strenuously stated, yet one can not but realize from it that western Europe has too long been libeled in respect of its native aptitude for civilization. This is not constituted of bronze alone, nor is its trade-mark cremation. Thus, while an intensive outbreak of culture of a [Pg 19] high order may not have arisen west of the Alps, it can no longer be denied that the general standard of intelligence was surely rising of its own native volition.

II. *Throughout the eastern Alpine highlands, a culture far more highly evolved than the neolithic one in the West, and betraying certain Oriental affinities, appears at a very early time, a thousand years or more before the Christian era. This prehistoric civilization represents a transitional stage between bronze and iron.*

In a secluded valley in upper Austria, close to the border line of Salzburg, by the little Alpine hamlet of Hallstatt, a remarkable necropolis was discovered more than a half century ago, which marked an epoch in archæological research. Excavations at this place alone, far from any present considerable seat of population, have already revealed more than three thousand graves. The primitive culture here unearthed, represented by all kinds of weapons, implements, and ornaments, bore no resemblance to any of the then known classical ones of the Mediterranean basin. Its graves contained no Roman coins or relics. There was nothing Greek about it. It contained no trace either of writing or chronology. It was obviously prehistoric; there was no suggestion of a likeness to the early civilizations in Scandinavia. It was even more primitive than the Etruscan, and entirely different from it, especially in its lack of the beautiful pottery known to these predecessors of the Romans. Little wonder that von Sacken, who first adequately described it in 1868, and Hochstetter, who worthily carried on his researches, believed that Hallstatt represented an entirely indigenous and extinct Alpine civilization. On the other hand, so exceedingly rich and varied were the finds in this out-of-the-way corner of Europe, that another and quite different view seemed justifiable. Might this not be an entirely exotic culture? products gained by trade from all parts of the world, being here deposited with their dead by a people who controlled the great and very ancient salt mines hereabouts? Neither of these interpretations of this find at Hallstatt have been exactly verified by later researches, and yet its importance has not lessened in the least. By later discoveries all over eastern Europe south of the Danube, from the Tyrol over to the Balkan peninsula, as well as throughout northern Italy, Würtemberg, and even over into northeastern France, the wide extension of this civilization[6] proves that it must in a large measure have developed upon the spot, and not come as an importation from abroad. On [Pg 20] the other hand, its affinity in many details with the cultures both of Italy and Greece proved that it had made heavy drafts upon each of these, profiting greatly thereby. The best opinion to-day is, that it constitutes a link in the chain of culture between eastern and western Europe. As such it is of primary importance in any study of European origins.

The primitive stage of European civilization, to which the term Hallstatt is specifically applied by archæologists, is characterized by a knowledge both of bronze and iron, although the latter is relatively insignificant. Its rarity indicates that we have to do with the very beginnings of its use. [Pg 21] In this early combination of bronze and iron the Hallstatt culture is in strong contrast with the rest of Europe. Almost everywhere else, as in Hungary for example, a pure bronze age—sometimes one even of copper also—intervenes between the use of stone and iron. Here, however, the two metals, bronze and iron, appear simultaneously. There is no evidence of a use of bronze alone. Bearing in mind, what we shall subsequently emphasize in the case of Scandinavia, that in that remote part of Europe man had to put up with the inferior metal for close upon a thousand years before the acquisition of a better substitute, it will be seen that at Hallstatt a remarkable foreshortening of cultural evolution had ensued. Iron, as we have said, was still comparatively rare. Only in the case of small objects, less often in the blades of bronze-handled swords, does this more precious metal appear. But it is far more common than in the earliest Greek civilizations made known to us by Schliemann and others.

Pages of description would not give so clear an idea of this early civilization as the pictures of their lives, which the Hallstatt people have fortunately left to us. These are found in *repoussé* upon their bronzes, and particularly upon their little *situlæ*, or metallic pails. These *situlæ* are, in fact, the most distinctive feature among all the objects which they have left to us. By means of them their civilization has been most accurately traced and identified geographically. On the opposite page we have reproduced the design upon the most celebrated of these *situlæ*, discovered by Deschmann in 1882, at Watsch in the Tyrol. Another from Bologna, typical of the pre-Etruscan Italian time, will be found upon a later page. Upon each of these, the skill manifested in the representation of men and animals is no less remarkable than the civilization which it depicts. The upper zone of this *situla* from Watsch apparently shows a festal procession, possibly a wedding, for a lady rides in the second chariot. The grooms and outriders betoken a party of distinction. As for the second zone, doubt as to its exact interpretation prevails. Hochstetter declares it to be a banquet, food and entertainment being offered to the personages seated upon chairs at the left. Bertrand is disposed to give it more of a religious interpretation. As for the contest between gladiators armed with the cestus, all is plain. The spectators, judges, even the ram and the helmet for reward of the victor, are all shown in detail. It is not necessary for us to cite more evidence. A civilization already far from primitive is surely depicted. As for its date, all are agreed that it is at least as early as ten centuries before Christ;[7] not far, that is to say, from the supposed Homeric epoch in

Greece.

[Pg 22]

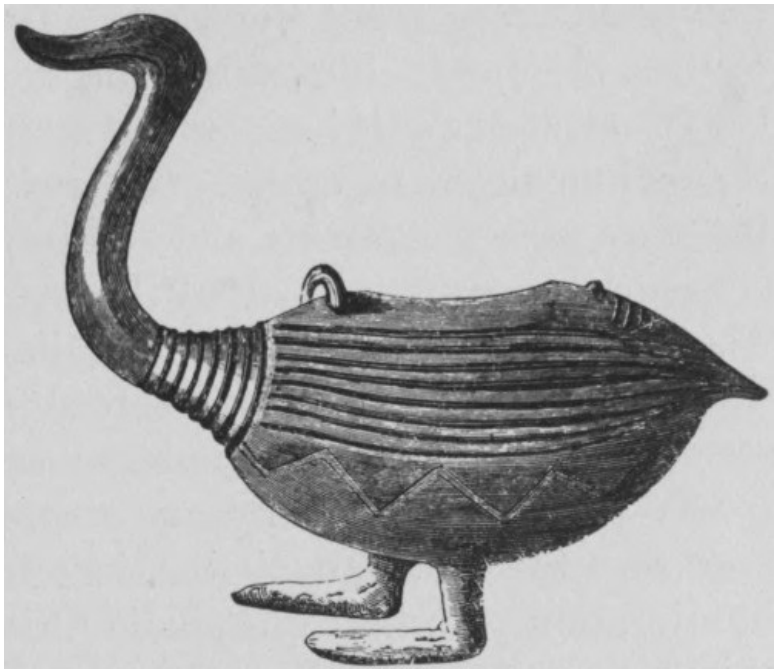
The Hallstatt civilizations betray unmistakable affinities with three other prehistoric European cultures, widely separated from one another. It contains many early Greek elements; it is very similar to a notable prehistoric culture in the Caucasus Mountains; and it resembles most nearly of all perhaps the pre-Etruscan civilization in Italy. With the third of these—the Italian—it seems to have been most nearly upon terms of equality, each borrowing from the other, after a fashion of which we shall have occasion to speak shortly. On the other hand, the relation of the Hallstatt culture to that of Greece and Caucasia seems to be somewhat more filial rather than fraternal. In describing the area of this civilization, we have seen how firmly it is intrenched all through the southern part of Austria-Hungary and well over into the north of the Balkan peninsula. A comparison of Furtwaengler's magnificent collection of objects from Olympia with those of Hallstatt instantly reveals their similarities. To make this clear, we have reproduced one of the Olympian breastplates, ornamented with figures, which at once suggest those upon the *situla* from Watsch above described. This design is doubly interesting. It shows us a slightly higher stage of the art of figural representation, as well as of conventional design. Not only the men and horses, but the borders, are far better drawn. More than this, we begin to detect a distinctly Oriental motive in other details. The bulls and the lions—lions are not indigenous to Europe nowadays—at once remind us of their Babylonian and Assyrian prototypes. We have entered the sphere of Asiatic artistic influence, albeit very indistinctly. This design here represented, it should be said, is rather above the average of the Olympian finds of the earlier epoch. Many of the other objects, especially the little votive figures of beasts and men, are much more crude, although always characteristic and rudely artistic in many ways. Through this Olympian stage of culture we pass transitionally on to the Mycenæan, which brings us into the full bloom of the classic Greek.

[Pg 23]

Bronze Situla.
Watsch, Austrian Tyrol.
[Larger Image]

Bronze Breastplate from Olympia.
(After Furtwaengler's Olympia, 1892.)
[Larger Image]

The Oriental affinities of the Hallstatt culture have been especially emphasized by recent archæological discoveries at Koban, in the Caucasus Mountains. A stage of culture transitional between bronze and iron, almost exactly equivalent to that of the eastern Alps, is revealed. Similarities in little objects, like fibulæ, might easily be accounted for as having passed in trade, but the relationship is too intimate to be thus explained. Hungary forms the connecting link between the two. In many respects its bronze age is different from that of Hallstatt, notably in that the latter seems to have acquired the knowledge of iron and of bronze at about the same time. In Hungary the pure bronze age lasted a long time, and attained a full maturity. A characteristic piece is represented herewith. In respect of the representation of figures of animals such as these, Hallstatt, Hungary, and Koban are quite alike.



HUNGARIAN BRONZE VESSEL. (After Hampel, 1876.)

Have we proved that bronze culture came from Asia by reason of these recent finds in the Caucasus? Great stress has been laid upon them in the discussion of European origins. Are we justified in agreeing with Chantre that two currents of culture have swept from Asia into Europe —one by the Caucasus north of the Black Sea and up the Danube; the other across Asia Minor [Pg 24] and into the Balkan peninsula, thence joining the first in the main center of Hallstatt civilization, east of the Alps? The point seems by no means established. Relationship does not prove parentage. Far more likely does it appear that the Koban culture is a relic or an offshoot rather than a cradle of bronze civilization. And even Chantre, ardent advocate as he is of Oriental derivations, seems to feel the force of this in his later writings, for he confesses that Koban is rather from Mediterranean European sources than that Europe is from Koban. Most probable of all is it, that both Hallstatt and Koban are alike derived from a common root in the neighborhood of Chaldea.

III. *The Hallstatt (or Celtic?) civilization of bronze and iron roughly overlies the present area occupied by the broad-headed Alpine race; yet this type is not always identified with the Oriental culture. It seems to have appeared in Europe in a far lower stage of civilization, and to have subsequently made progress culturally upon the spot.*

To trace any definite connection between race and civilization in Europe is rendered extremely hazardous scientifically by reason of the appearance along with bronze of the custom of burning instead of burying the dead, their ashes being disposed in cinerary urns, jars, or other receptacles. By this procedure all possible clew to the physical type of the people is, of course, annihilated at once. It has become almost an axiom among archæologists that bronze culture and incineration are constant companions. Wherever one appears, the other may confidently be looked for. Together they have long been supposed to be the special and peculiar attributes of a new broad-headed immigrant race from the East. To prove this conclusively is, of course, absolutely impossible for the above-mentioned reason. Of the two, it seems as if incineration would be a more reliable test of race than a knowledge of bronze; for burial customs, involving as they do the most sacred instincts and traditions of a people, would be most persistently maintained, even throughout long-continued migrations. The use of bronze, on the other hand, being a matter of obvious utility, and capable of widespread dissemination commercially, is seemingly of far less ethnic significance.

To indicate the uncertainty of proof in these matters, let us suppose that the Hallstatt civilization, for example, is the result of an immigration of a brachycephalic Oriental civilized race overlying a primitive native long-headed one. That seems best to conform to the data, which northern Italy at least affords. Suppose the new people—call them Celts with the best authorities, if you please—brought not only bronze and iron, but the custom of incineration. Prior to their appearance inhumation was the rule. What would be the result if one attempted to determine the physical character of that people from a study of the remains in their necropoli? All the crania to be found [Pg 25]

in the graves with the precious objects of bronze would in no wise represent the people who brought that bronze. They burned their bridges behind them at death, and disappeared for good and all. And the remains left to the archæologist would represent precisely that class in the population which had nothing to do with the main characteristics of its civilization. And then, again, we must bear in mind that the interments in these necropoli as a whole, both with burned or buried dead, constitute a selected type. Neither Hallstatt, Watsch, nor any of the burial places of their type were open to the great mass of the common people. They were sacred spots, far removed among the mountains from any centers of population. Only the rich or powerful presumably had access to them. They are no more typical of the Hallstatt people, therefore, than interments in Westminster Abbey are representative of the English masses. All our data are necessarily drawn from a class within a class. Inductions from them must be very gingerly handled.

The situation above described seems to prevail almost everywhere in the Hallstatt cultural area. Two distinct burial customs denote possibly two separate peoples, the inhumers being certainly the older. In the Hallstatt necropolis, for example, about one third of the graves once contained human remains, all the others containing mere ashes. So ancient are these graves that only eight crania from the hundreds of interments of the first class are available for study. These are of a pronounced long-headed type.[8] The modern populations of this part of Europe are, as we have seen, among the broadest-headed people in the world, as are also all the modern Illyrians. Yet from the great necropolis at Glasinac in Bosnia, with its twenty thousand tumuli, the meager Hallstatt returns are amply corroborated.[9] The ancient inhabitants were as long-headed as they are pronouncedly of the opposite type to-day. Up in Bohemia and Moravia also, according to Niederle, the first bronze-age people, such as we know them, were still dolichocephalic quite like their predecessors in the pure stone age. And here also is incineration just about frequent enough to make it uncertain whether the human remains are typical or not.

Under these circumstances, three suppositions are open to us. We may hold that these long-headed crania of the Hallstatt people are worthless for any anthropological purposes whatever. This one would certainly be tempted to do were the testimony, such as it is, not so unanimous. Or, secondly, we may assume that these long-headed Hallstatt people belonged to a period subsequent to the appearance of the brachycephalic type in western Europe. If we do so, we place them in the same class with the Teutonic race which so certainly appears to overlie this one [Pg 26] in the later iron age in Switzerland and throughout southern Germany; for the Helvetians and the *Reihengräber* conquerors from the north surely imposed a novel culture, albeit a militant one, upon the long-settled Alpine people, racially speaking. The Hallstatt civilization is immeasurably too early to permit of this hypothesis. At this time the long-headed Teutonic peoples about Scandinavia were certainly vastly inferior in culture, as we shall attempt to prove shortly. Thus we are forced to the third conclusion if we admit the competency of our cranial evidence—namely, that the Hallstatt people in this early bloom of civilization in Europe were allied to the Mediterranean type of the south. No other source for such a dolichocephalic population is possible. Our stock of types of this kind is exhausted.

It does not require a great credulity to admit of this hypothesis, that the Hallstatt people were of Mediterranean type. Were not the Greeks, the Phœnicians, and the Egyptians all members of this same race? One single difficulty presents itself. Over in Italy, throughout the valley of the Po, an entirely analogous civilization to that of the eastern Alps occurs. Hallstatt and Villanova, Watsch and Bologna, are almost identical culturally. And yet over here in Italy the new culture of bronze and of incineration seems to be borne by a broad-headed people of the same type as the modern one. Thus, for example, at Novilara so long as the bodies were all inhumed, the people were of the long-headed Mediterranean type once indigenous to the whole of Italy, now surviving, as we have seen, only in the southern half. On the other hand, when incineration begins to appear in this place, the human remains still left to us are of a mixed and far more broad-headed type. It would seem admissible to assume that when the modern brachycephalic Alpine race submerged the native one it brought new elements of civilization with it. Many Italian authorities, at all events, agree in ascribing the new culture—call it Umbrian with Sergi, or proto-Etruscan with Helbig—to a new race of Veneto-Illyrian or Alpine physical proclivities. What they have not definitely proved, however, is that any necessary connection between race and culture exists. There is much to show that the broad-headed race came in some time before the introduction of the new arts. Even in the later *Terramare* period, preceding the Italian Hallstatt culture, when stone and copper only are in evidence, a change of physical type in the people apparently begins, just as also in France in the neolithic period.

The most indubitable testimony that the Alpine race did not appear in western Europe, armed *cap-à-pie* with bronze and other attributes of culture, is afforded by the lake dwellings of Switzerland. Here in the pile-built villages of the Swiss lakes we can trace an uninterrupted [Pg 27] development of civilization from the pure stone age through bronze and into iron. Beginning at a stage of civilization about equal to that of the ancient Aryan-speaking peoples, judged by the root words known to us; not only knowledge of the metals, but of agriculture, of the domestication of animals, and of the finer arts of domestic life, have little by little been acquired. Equally certain is it that no change of physical type has occurred among these primitive Swiss, at least until the irruptions of the Teutonic Helvetians and others at the opening of the historic period. From the very earliest times in the stone age a broad-headedness no less pronounced than that of the modern Swiss prevailed among these people.[10] Here would seem to be pretty conclusive proof that the Alpine race entered Europe long before the culture with which its name has been all too

intimately associated.

In the outlying parts of Europe, perhaps even in Gaul, it is extremely doubtful whether any closer connection between race and culture exists than in the Alps. It has long been maintained that the brachycephalic people of the Round Barrows introduced bronze into Britain. Surely, as we have already shown, things point to that conclusion.[11] Beddoe, Dawkins, and other authorities maintain it at all events. Yet Canon Taylor makes it pretty evident that the new race arrived in Britain, as it certainly did in Gaul, considerably in advance of any knowledge of the metals. As for Scandinavia, much the same relation holds true. Both race and culture, as we shall see, came from the south, but it is by no means clear that they arrived at the same time or that one brought the other. In Spain, Siret has asserted that bronze came in the hands of a new immigrant broad-headed race, but the authoritative opinion of Cartailhac discovers no direct evidence to this effect.

The final conclusions which would seem to follow from our tedious summary is this: That the nearly contemporaneous appearance of a brachycephalic race and the first knowledge of metals indicative of Oriental cultural influences in western Europe, is more or less a coincidence. The first civilized peoples of the Hallstatt period seem to have been closely allied, both in physical type and culture, with the Greeks and other peoples of the classic East. Among them, perhaps over them, swept the representatives of our broad-headed Alpine type who came from the direction of Asia. These invaders may have been the Scythians, although the matter is incapable [Pg 28] of proof. Pressure from this direction set both culture and population in motion toward the west, in much the same way that the fall of Constantinople in the fifteenth century induced the Renaissance in Italy.

IV. *The remarkable prehistoric civilization of Italy is due to the union of two cultures: one from the Hallstatt region having entered Europe by way of the Danube, the other coming from the southeast by sea being distinctly Mediterranean. From these evolved the Umbrian and the Etruscan civilizations, followed in the historic period by the early Latin.*

The earliest culture in Italy worthy the name is found in the *palafitte* or pile dwellings, in the northern lakes, and in the so-called *terramare* settlements in the valley of the Po. The former are not distinguishable from similar structures in the Swiss lake dwellings, but the *terramare* are entirely peculiar to Italy. Their like is not found anywhere else in Europe. Briefly described, they are villages built upon raised platforms of earth, encircled by a moat, and generally having a ditch or small pond in the middle, in which an altar is erected. These complicated structures are built upon the low, marshy, alluvial plains along the Po, but show many points of similarity with the true pile dwellings. The people of this early period were in the pure stone age, with few arts save that of making the coarser kinds of pottery. From their osseous remains, they seem to have been of a long-headed type, quite like their predecessors, who were cave dwellers. After a time, without any modification of the modes of construction of their settlements, new elements appear among these *terramare* people, bringing bronze and introducing cremation. At about the same period, as we have said, the Alpine broad-headed race began its submergence of the primitive Ligurian type, leading to the formation of the north Italian population as we see it to-day. This type surely invaded Italy from the north and northeast.

From the foregoing considerations it will appear that there were two constituent streams of culture and also of men here uniting in the valley of the Po and on the northern slopes of the Apennines. Possibly, as Chantre affirms, these two streams were from a common Oriental source, here being reunited after long and independent migrations. At all events, a remarkable advance in culture speedily ensued, superior to either of those from which its elements were derived. For the civilization unearthed at Villanova, in the Certosa at Bologna, at Este, and elsewhere, while in much of its bronze work similar to the Hallstatt types, contained a number of added features, obviously either indigenous or brought directly from the south. The Hallstatt affinities are especially revealed in the *situlæ* to which we have already called attention. That of Arnoaldi, discovered at Bologna, betrays much the same grade of skill in manufacture as the one from [Pg 29] Watsch. Its flat development is shown by the accompanying cut. The scenes represented are not dissimilar. The boxers armed with the cestus, the chariots, and horses closely resemble one another. No doubt of a close intercourse between the two regions of Bologna and Austria can possibly exist.

Arnoaldi Situla, Bologna.
(From Revue Archéologique, 1885, vol. ii, Plate XXV.)
[Larger Image]

The influence of the second or native element in prehistoric Italian civilization appears most clearly in the Etruscan period. Etruria, lying south of the Apennines, was more essentially Italian, as we might expect, than the region about Bologna, where the Umbro-Hallstatt or continental culture flourished. It is easy to note the superiority in the former case. It is most clearly indicated in the pottery. Here we find an art which is truly indigenous to the climate and soil of the Mediterranean.

Popularly, the word "Etruscan" at once suggests the ceramic art; the progress effected in a short time was certainly startling. To give an idea of the sudden change, we have reproduced upon page 30 illustrations of typical bits of Italian pottery.[12] The first vase, prior to the full Etruscan culture, shows its crudity at once, both in its defects of form and the plainness and simplicity of its ornamentation. Such a vessel might have been made in Mexico or even by our own Pueblo Indians. In a century or two some teacher made it possible to produce the sample depicted in the next cut. Perfect in form, superb in grace of outline, its decoration is most effective; yet it betrays [Pg 30] greater skill in geometrical design than in the representation of animate life. The dog drawn on the girdle is still far from lifelike. Then come—probably after inspiration from Greek art—the possibilities in complex ornamentation represented by our third specimen. Not more pleasing in form, perhaps less truly artistic because of its ornateness, it manifests much skill in the delineation of human and animal forms. The culture culminates at this point. From profusion of ornament and overloaded decoration, degeneracy begins. It is the old story of the life and decay of schools of art, time in and time out, the world over.

Early Etruscan. **Later Etruscan.** **Greek Etruscan.**
[Larger Image]

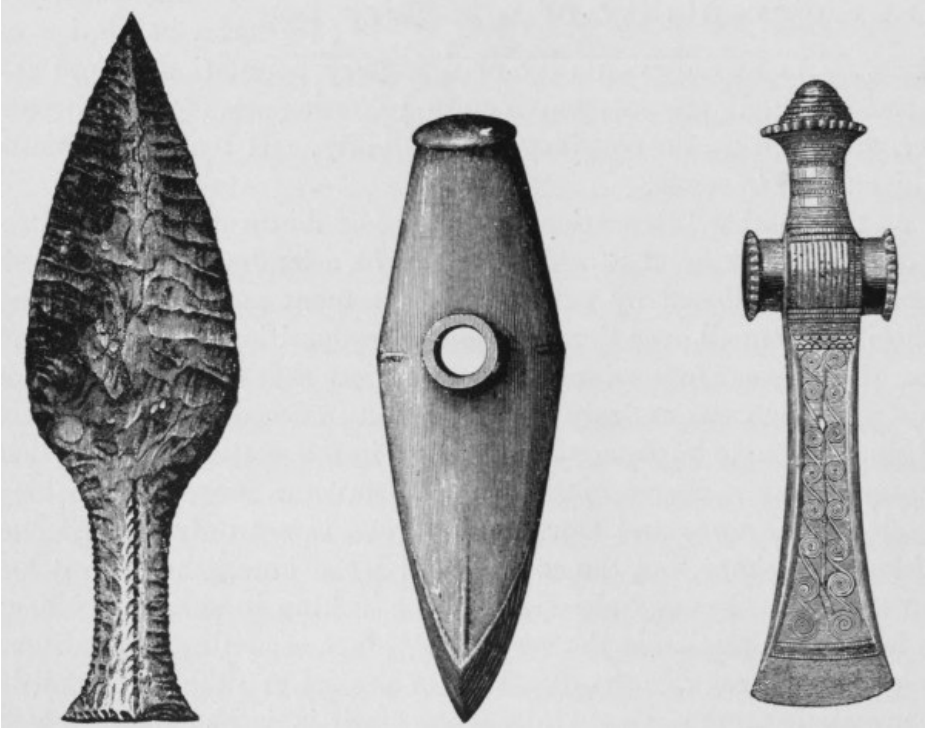
The advance in culture typified by our vases was equaled in all the details of life. The people built strongly walled cities; they constructed roads and bridges; their architecture, true predecessor of the Roman, was unique and highly evolved. All the plain and good things of life were known to these people, and their civilization was rich in its luxury, its culture and art as well. In costumes, jewelry, the paraphernalia of war, in painting and statuary they were alike distinguished. Their mythology was very complex, much of the Roman being derived from it. Most of our knowledge of them is derived from the rich discoveries in their chambered tombs, scattered all over Italy from Rome to Bologna. There can be no doubt of a very high type of civilization attained long before the Christian era. Roman history is merged in the obscurity of time, five or six hundred years later than this. The high antiquity of the Etruscan is therefore beyond question. But its highly evolved art and culture show that we have no longer to do with European origins; to discuss it further would lead us to trench upon the field of classical rather than prehistoric archæology.

V. *The northwestern corner of Europe, including Scandinavia, Denmark, and the Baltic plain of* [Pg 31] *Germany, throughout the prehistoric period has been characterized by backwardness of culture as compared with the rest of Europe. It was populated from the south, deriving a large part of such primitive civilization as it possessed from the south and the southeast as well.*

That this region was necessarily uninhabited during the Glacial epoch, long after the advent of man in southern Europe, is indubitable. It is proved by the extent of the glaciated area, which extends on the mainland as far south as Hamburg, Berlin, and Posen, and over the entire British Isles at the same time.[13] It was by the melting of this vast sheet of ice that those high level river terraces in France and Belgium were formed, in which the most ancient and primitive implements of human manufacture occur. In the area beneath this ice sheet no trace of human occupation until long after this time occurs. This fact of itself, is not absolutely conclusive, for glaciation would have obliterated all traces of anterior habitation or activity. As to the possibility of a tertiary population before the Glacial epoch, it presents too remote a contingency for us to consider, although we do not deny its possibility. It too far antedates prehistory, so to speak.

At the notable International Congress of Anthropology and Prehistoric Archæology at Stockholm

in 1874 a landmark in these sciences was established by substantial agreement among the leading authorities from all over Europe upon the proposition now before us.[14] First of all, every one subscribed to the view that the palæolithic or oldest stone age was entirely unrepresented in Sweden. The earliest and simplest stone implements discovered in the southern part of that country betray a degree of skill and culture far above that so long prevalent in France and Germany. Stone is not only rubbed and polished into shape, but the complicated art of boring holes in it has been learned. Norway also seems to be lacking in similar evidence of a human population in the very lowest stage of civilization. Stone implements anterior to the discovery of the art of rubbing or polishing are almost unknown. Only about Christiania have any finds at all been made. In Denmark some few very rude implements have been found. They are so scarce as to suggest that they are mere rejects or half-finished ones of a later type. The kitchen middens, [Pg 32] or shell heaps, of Jutland, for which the region is most notable, as described by Steenstrup, abound in stone implements. They all represent man in the neolithic age. Polished stones are as abundant as the rudely hammered ones are rare. From the absence of all the very early stone implements, and from the sudden appearance of others of a far more finished type, the possibility of a gradual evolution of culture about Scandinavia *in situ* is denied on all hands. The art of working stone has surely been introduced from some more favored region. The only place to look for the source of this culture is to the south.



Flint Dagger. (From Montelius, 1895 b.)

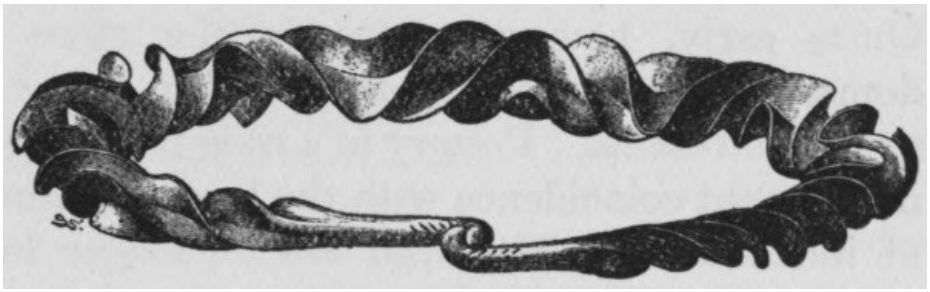
Stone Axe. (From Montelius, 1895 b.)

Bronze Axe. (From Montelius, 1895 b.)

Tardy in its human occupation and its stone culture, Scandinavia was still more backward, as compared with the rest of Europe, in its transition to the age of bronze. This is all the more remarkable in view of the rich store of raw materials on every hand. Nowhere else in Europe does the pure stone age seem to have been so unduly protracted. A necessary consequence of this was that stone-working reached a higher stage of evolution here than anywhere else in the world save in America. In other parts of Europe the discovery of metal-working, of course, immediately put an end to all progress in this direction. The ultimate degree of skill to which they attained is represented in the accompanying cuts. The first, a flint poniard, shows the possibilities, both in the line of form and finish, of manufacture by the chipping process. To equal this example one must look to the most skillful of the American Indians, as in Tennessee, where [Pg 33] they were too remote from mines of native copper to make use of a ready substitute for stone. Our second implement is an axe hammer, made of diorite. To shape, sharpen, bore, and polish a piece of stone like this certainly required a long apprenticeship in the art.

Bronze culture, when it did at last appear in this remote part of Europe, came upon the scene suddenly and in full maturity. Whether this was as early as the eighth to the tenth century, as Montelius avers, is disputed by many. All are nevertheless agreed that evidence is absolutely lacking that the art was of indigenous origin. From what part of the world this knowledge of bronze ultimately came we leave an open question, as also whether it came with Phœnician traders or direct from Greece, as Worsaae affirms. It was certainly introduced into Sweden, making its way into Norway about the same time directly from the peninsula of Jutland. Its first appearance is in a highly evolved state. Such crude attempts at manufacture as Chantre finds so long prevalent along the Rhone Valley, for example, are entirely absent. Both in form and ornamentation the hand of the master is apparent. This bronze age, like that of stone, lasted a very long time—far longer than anywhere else on the continent. Central Europe passed through three stages of metallic progress while Scandinavia was evolving two. Not until the second or third century of our era—not until the time of the Romans, it would appear—did iron begin to

supplant bronze. History repeats itself. The excessive duration of the bronze age, as in the case of stone antecedently, led to the attainment of a remarkable skill. The two accompanying cuts are typical of the best work of this time. In the one case, merely superficial ornament, especially the skillful use of the spiral; in the other, real beauty of form in the bracelet, are clearly apparent. Possessed of such skill in the working of bronze, it is small wonder that the need of a better metal was not felt. Only when fashioned into weapons of war does iron reveal its supremacy over bronze. This, of course, with the campaigns of historical times, brings us to the end of our chronicle.



Bronze Bracelet: 650-500 b. c. (From Montelius, 1895 b.)

The prehistoric experience of metal-working in Scandinavia is typical of the other details of its cultural evolution. In its earliest epoch no trace of domestic animals is present. It is rather a remarkable fact that even the reindeer seems to have been unknown.[15] What can Penka say to this in his positive affirmation that the original Aryans got up into Scandinavia, having followed the reindeer from central Europe north after the retreat of the ice sheet? The fact is, archæologically speaking, from the evidence furnished by the kitchen middens, that if they ever did this "they left a fine country, where deer were plenty, to subsist upon shellfish on the foggy coasts of Denmark."[16] The entire absence of economic motive for such a migration is at once apparent. Men seldom travel far under such conditions. Quite early, however, even in the stone age, do evidences of domestic animals occur, to the dog being added the ox, horse, swine, and sheep. Pottery in a rude form also follows. Finally, and in apparent coincidence with the bronze culture, comes a new custom of incineration. The dead are no longer buried, but burned. A profound modification of religious ideas is hereby implied. It seems to have been at about this time also that our Alpine racial type entered Scandinavia from Denmark, although, as we have already observed, it is yet far from certain that the new race was the active agent in introducing the new elements of culture. All that we know is that they both came from the south, and reached this remote region at about the same time. [Pg 34]

That the origins of culture in Europe are certainly mixed would seem to be about the main conclusion to be drawn from our extended discussion. It has an iconoclastic tone. Yet we would not leave the matter entirely in the air, nor would we agree with Mantegazza (1884) in his conclusion that "Ignoramus" sums up our entire knowledge of the subject. There is some comfort to be drawn even from this mass of conflicting opinions. Our final destructive aim has been achieved if we have emphasized the danger of correlating data drawn from several distinct sciences, whose only bond of unity is that they are all concerned with the same object—man. The positive contribution which we would seek to make is that the whole matter of European origins is by no means so simple as it has too often been made to appear. It is not imperative that conclusions from all the contributory sciences of physical anthropology, philology, and cultural history should be susceptible of interweaving into a simple scheme of common origins for all. The order of races, for example, need mean nothing as respects priority of culture. Nor do the two sciences, philology and archæology, involve one another's conclusions so far as civilization is concerned. Language and industrial culture may have had very different sources; their migrations need stand in no relation to one another in the least. Each science is fully justified in its own deductions, but must be content to leave the results of others in peace. Such is the ultimate conclusion to which all the latest authority is tending. Only by a careful comparison of data from each sphere of investigation may we finally hope to combine them all in a composite whole, as many-sided and complex as the life and nature of man itself. [Pg 35]

LIQUID AIR.

By IRA REMSEN,

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Water, the substance most familiar to us, is known in the liquid, in the solid, and in the gaseous state. Everybody knows that by heating the solid it passes into the liquid state, and that by heating the liquid it passes into the form of gas or vapor. So also everybody knows that when the vapor of water is cooled it is liquefied, and that by cooling liquid water sufficiently it becomes solid or turns to ice. In the same way many of the substances that are known to us as liquids,

such as alcohol and ether, can be converted into the form of gas or vapor by heat. In fact, this is true of most liquids. The temperature at which a solid passes into the liquid state is called its melting point, and the temperature at which a liquid passes into the gaseous state is called its boiling point. The boiling point of water, for example, is 100° C. (212° F.) in the open air. But the boiling point varies with the pressure exerted upon the surface. The pressure that we ordinarily have to deal with is that of the atmosphere. If the pressure is increased the boiling point is raised, and if the pressure is decreased the boiling point is lowered. In dealing, then, with the conversion of a gas into a liquid, or that of a liquid into a gas, both the temperature and the pressure have to be considered.

Just as water is most familiar to us in the liquid form, so there are substances that are most familiar to us in the gaseous form. In fact, the only gaseous substances that can be said to be familiar to everybody are the gases contained in the air. The principal constituents of the air are nitrogen and oxygen, which form respectively about four fifths and one fifth of its bulk. Besides these gases, however, the air contains water vapor, carbonic-acid gas, ammonia, argon in small quantities, and many other substances in still smaller quantities. For the purposes of this article it is only necessary to have in mind the nitrogen, oxygen, water vapor, and carbonic acid. Of these, the water vapor is easily converted into liquid, as, for example, in the formation of rain, [Pg 36] while the other constituents are liquefied with difficulty. The name "liquid air" is applied to the substance that is obtained by converting the air as a whole into a liquid; but in this process the water and the carbonic acid become solid and can be filtered from the liquid so that the latter consists almost wholly of oxygen and nitrogen. A few years ago this liquid was obtainable in only very small quantities. To-day, thanks especially to the efforts of Mr. Charles E. Tripler, of New York, it can be produced in any desired quantity, and at moderate cost. In consequence of this, it has come to be talked about in a familiar way, and many persons have had the privilege of seeing and feeling it, and of learning something about its wonderful properties. The object of this article is to explain the method employed in the production of liquid air, to give an account of some of its properties, and to indicate some of the uses to which it may possibly be put.

In the older text-books of physics and of chemistry certain gases were classed as "permanent," under the impression that these could not be liquefied, and this impression was based upon the fact that all efforts to liquefy them had failed. A brief account of these efforts will be helpful.

Among the so-called permanent gases was chlorine. An English chemist, Northmore, first succeeded, early in this century, in liquefying chlorine. His work was, however, lost sight of, and in 1823 Faraday at the Royal Institution showed independently that this transformation of gaseous chlorine into the liquid can be effected comparatively easily. The method used by him is this: When chlorine gas is passed into cold water it forms with the water a solid product known as chlorine hydrate. If kept well cooled this hydrate can be dried. If then its temperature is raised even to the ordinary temperature of the room, the solid hydrate is decomposed into liquid water and gaseous chlorine. Faraday put some of the solid hydrate into a stout glass tube sealed at one end and bent at the middle. The other end of the tube was then closed. The tube was then suspended so that the two ends were turned downward. On gently warming the end in which was the solid hydrate, this was decomposed into chlorine and water. But the gas given off would under ordinary conditions have occupied a much larger space than the solid hydrate. Being prevented from expanding by the tube in which it was inclosed, it was under very considerable pressure. The end of the tube that was not warmed was cooled, and in this end, in consequence of the pressure and the comparatively low temperature, chlorine, which is gaseous under the ordinary pressure of the air, appeared as a liquid. The general method made use of by Faraday in this classical experiment is that which is always made use of for the purpose of liquefying gases, [Pg 37] but for some gases pressures very much higher and temperatures very much lower are required. Faraday himself succeeded in liquefying all the gases then known except oxygen, hydrogen, nitrogen, nitric oxide, and marsh gas. He subjected oxygen to a pressure of about one thousand pounds to the square inch, or nearly seventy atmospheres, but it showed no signs of liquefaction. Later experimenters increased the pressure to four thousand pounds to the square inch, with no better results, so that it is not surprising that it came to be held that some gases are permanent.

Within comparatively recent years several gases have been liquefied on the large scale by means of pressure. These are ammonia, carbonic acid, nitrous oxide, and chlorine. Ammonia is used for producing low temperatures, as in breweries and in cold-storage plants and in the manufacture of ice; carbonic acid, for fire extinguishers and for charging beer with the gas; nitrous oxide, for producing anæsthesia; and chlorine in connection with several branches of chemical manufacture. The production of low temperatures by means of liquid ammonia and of liquid carbonic acid will be more fully dealt with further on, when the principles involved will be briefly presented. It is to be borne in mind that these substances are liquefied by means of pressure alone, at temperatures that are easily reached, so that it appears that by mechanical pressure it is possible to produce low temperatures. In 1869 an important fact was discovered by Andrews. It was that for every gas there is a temperature above which it is impossible to liquefy it by pressure. Thus, if chlorine is at any temperature above 146° C. (294° F.) it can not be liquefied. This temperature is called the "critical temperature" of chlorine. The pressure to which the gas must be subjected at the "critical temperature" in order that the gas may be liquefied is called the "critical pressure." In the case of chlorine this is 93.5 atmospheres. Now, the critical temperature of the gases that were called permanent gases are very low—lower than could be reached by the means at the command of earlier experimenters. The critical temperature of oxygen, for example, is -118.8° C. (-182° F.), while that of nitrogen is -146° C. (-230° F.). The critical pressures are 50.8 and 35 atmospheres respectively. As there is no difficulty in obtaining

these pressures, the problem of liquefying oxygen and nitrogen and air resolves itself into finding a method of producing temperatures below the critical temperatures of these gases.

It is well known that a temperature somewhat below the freezing point of water can be produced artificially by mixing ice and salt. The ordinary ice-cream freezer is a familiar application of this method of producing cold. Other freezing mixtures that are sometimes used consist of calcium chloride and snow, that gives the temperature -48° C. (-54.4° F.), and solid carbonic acid and [Pg 38] ether, that is capable of lowering the temperature to -100° C. (-148° F.). But even with the latter mixture it is not possible to reach the critical temperature of oxygen or that of nitrogen. How, then, is it possible to reach these extremely low temperatures?

In order to answer this question it will be necessary to take into consideration certain temperature changes that are observed when solids are melted and liquids are boiled, as well as when gases are liquefied and liquids are frozen. When heat is applied to a mass of ice at its melting point it melts and forms a mass of water having the same temperature. Heat disappears in the operation. It is stored up in the water. This disappearance of heat that accompanies the melting of ice can be shown in a very striking way by mixing a certain weight of ice with the same weight of water that has been heated to 80° C. (176° F.). The ice will melt and all the water obtained will be found to have the temperature of the melting ice—that is, 0° C. (32° F.). The water of 80° C. is thus cooled down to 0° by the melting of the ice. Again, when heat is applied to water its temperature rises until the boiling point is reached. Then it is converted into vapor, but this vapor has the temperature of the boiling water. During the process of boiling there is no rise in the temperature of the water or of the vapor. Heat disappears, therefore, or is used up in the process of vaporization. Similar phenomena are observed whenever a solid is melted or a liquid is boiled. When, however, a gas is liquefied it gives up again the heat that is absorbed by it when it is formed from a liquid; and so also when a liquid solidifies it gives up the heat it absorbs when it is formed from a solid.

But it is not necessary that a gas should be converted into a liquid in order that it should give up heat. Whenever it is compressed it becomes warmer. Some of the heat stored up in it is, as it were, squeezed out of it. Conversely, whenever a gas expands, it takes up heat and, of course, surrounding objects from which the heat is taken become colder. Now, it is a comparatively simple matter to compress air. Every wheelman knows that, and he also knows that the process causes a rise in temperature; at least he knows it if he uses a small hand pump. With large pumps run by steam any desired pressure can be reached. This is simply a question of securing the proper engines, and vessels sufficiently strong to stand the pressure. It has already been pointed out that several gases are now liquefied on the large scale by means of pressure. It is to be noted that low temperatures can be produced by converting certain gases, such as ammonia and carbonic acid, into liquids, and by compressing certain gases, as, for example, air. When liquefied gases are used it is only necessary to allow them to pass rapidly into the gaseous state, when [Pg 39] more or less heat is absorbed. This is the basis for the use of liquid ammonia in the manufacture of ice. A vessel containing the liquid ammonia is placed in another containing water. The inner vessel being opened, the liquid ammonia is rapidly converted into the gas; heat is absorbed from the water; it freezes. When a vessel containing liquid carbonic acid is opened so that the gas that is formed escapes through a small valve, so much heat is absorbed that a part of the liquid carbonic acid is itself frozen. In this case the substance is present in all three states of aggregation—the solid, the liquid, and the gaseous. The use of a mixture of ether and solid carbonic acid as a freezing mixture has already been referred to. Its value depends, of course, principally upon the fact that solid carbonic acid is liquefied, and the liquid then converted into gas, both of which operations involve absorption of heat.

We are now prepared to understand the important experiments of Cailletet and of Pictet, the results of which were published in 1877. It should be said that they worked independently of each other—Cailletet in Paris and Pictet in Geneva. Pictet liquefied carbonic acid and sulphur dioxide by pressure. The liquid carbonic acid was passed through a tube that was surrounded by liquid sulphur dioxide boiling in a partial vacuum. The liquid carbonic acid thus cooled was then boiled under diminished pressure in a jacket surrounding a tube in which the gas to be liquefied was contained under high pressure. When this gas was allowed to escape from a small opening its temperature was so reduced by the expansion that a part of it was liquefied in the tube and passed off as a liquid. Cailletet worked in essentially the same way, but on a smaller scale. Neither of these experimenters liquefied oxygen or nitrogen on the large scale, but they pointed out the way that must be followed in order that success may be attained. They destroyed the belief in "permanent" gases.

Later experimenters in this field are Wroblewski, Olszewski, and Dewar, who have been interested mainly in the purely scientific side of the problem, while Linde in Germany, Hampson in England, and Tripler in the United States have their minds on the practical side. Notwithstanding the low temperatures involved in the experiments, a number of heated discussions have been carried on in the scientific journals touching the question of priority. To the unprejudiced observer it appears that all of those named above are entitled to credit. They have all helped the cause along, but just how to apportion the credit no one knows. In a general way, however, some of the results obtained by each in turn should be given. Wroblewski and Olszewski have carried on the work begun by Cailletet and Pictet, and have produced lower [Pg 40] temperatures. In the latest form of apparatus used by Olszewski, liquid ethylene is used as the cooling agent. Its boiling point is -102° C. (-151.6° F.). By causing it to boil rapidly under diminished pressure a temperature below the critical temperature of oxygen can be reached. As

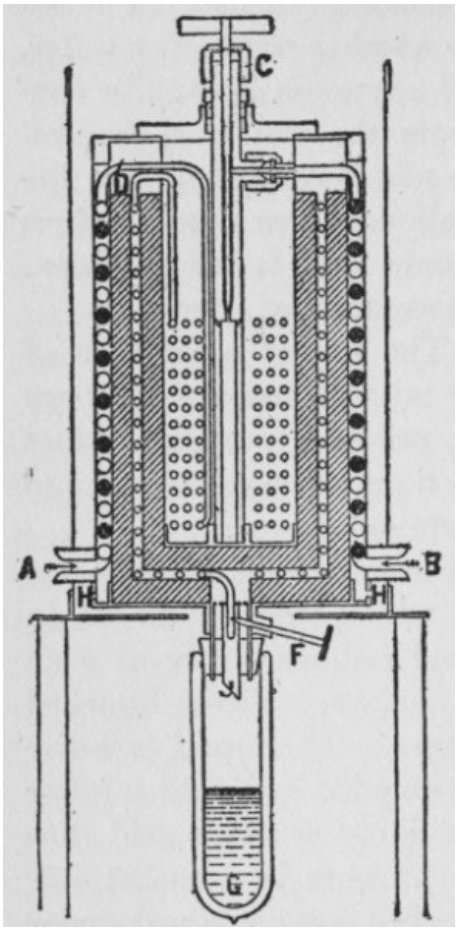


Fig. 1.—Laboratory Liquefaction Apparatus of Dewar for the Production of Liquid Oxygen, etc. A, air or oxygen inlet; B, carbon-dioxide inlet; C, carbon-dioxide valve; D, regenerator coils; F, air or oxygen expansion valve; G, vacuum vessel with liquid oxygen; H, carbon-dioxide and air outlet; ○, air coil; ●, carbon-dioxide coil.

early as 1891 Olszewski obtained as much as two hundred cubic centimetres of liquid air by this method. Dewar has also made use of liquid ethylene. This was passed through a spiral copper tube surrounded by solid carbonic acid and ether. It was then passed into a cylinder surrounded by another cylinder containing solid carbonic acid and ether. A spiral copper tube, which runs through the outer cylinder and also through the inner cylinder in which the ethylene was boiling under diminished pressure, carried the air. This was liquefied and then collected in a vacuum vessel below. Later he found that air can be liquefied by using liquid carbonic acid alone as the cooling agent. A sectional drawing of his apparatus described in 1896 is given herewith. As he remarks: "With this simple machine, one hundred cubic centimetres of liquid oxygen can readily be obtained, the cooling agent being carbon dioxide, at the temperature of -79°. If liquid air has to be made by this apparatus, then the carbonic acid must be kept under exhaustion of about one inch of mercury pressure, so as to begin with a temperature of -115°."

The introduction of the vacuum vessel by Dewar has been of great service in all the work on liquefied gases. A vacuum vessel is a double-walled glass vessel, as shown in Fig. 1, G. The space between the inner and outer walls of the vessel is exhausted by means of an air pump before it is closed. The vessel is therefore surrounded by a vacuum. As heat is not conducted by a vacuum, it is possible to keep specimens of liquefied gases in such vessels for a surprisingly long time. Heat enough can not pass through the vacuum to vaporize the liquid rapidly. The most [Pg 41] common form of these vessels is that of a globe. Such a vessel is known as a Dewar globe or bulb.

It has been found that liquid air can be kept very well by putting it in a tin or galvanized iron vessel, which in turn is placed in a larger one, and then filling the space between the two with felt. Under these conditions vaporization takes place quite slowly, and it is possible to transport the liquid comparatively long distances. It has, for example, been transported from New York to Baltimore and Washington. In one case with which the writer is familiar two cans were taken from Mr. Tripler's laboratory in the morning, delivered at the Johns Hopkins University in the afternoon, and used to illustrate a lecture in the evening. After the lecture there was enough left for certain experiments that were carried on during the rest of the night.

Tripler, Linde, and Hampson have all succeeded in devising forms of apparatus by means of which air can be liquefied without the aid of other cooling agents than the expanding air. In principle the methods employed by these three workers are essentially the same. It appears from the published statements that at the present time Tripler's plant is the most efficient. While a few years ago a half pint or so of liquid air is said to have cost five hundred dollars, now five gallons can be made for about twenty dollars, and probably much less. The general working of Tripler's apparatus can be made clear by the aid of the accompanying drawing, Fig. 2. A^1, A^2, A^3 represent steam compression pumps. Air is taken through I from above the roof of the laboratory. In the first pump it is compressed to sixty-five pounds to the square inch. It, of course, becomes heated as it is compressed. In order to cool it down again it is passed through a coil, B^1, which is surrounded by water of the ordinary temperature. This compressed and cooled air is then further compressed in the second pump, A^2, to four hundred pounds to the square inch. Again it is cooled [Pg 42] in the same way as before by means of water which circulates around the coil B^2. Once more the air is compressed, this time in the cylinder A^3, in which it is subjected to a pressure of two thousand to twenty-five hundred pounds to the square inch; and then this compressed air is brought down to the ordinary temperature in the cooler B^3. The air under this great pressure is now passed through the purifier C, where it is freed from particles of dust and to a great extent from moisture. From C the air passes into the inner bent tube, about thirty feet in length, until it reaches D. This may be called the critical point of the apparatus. Here is situated a needle valve from which the air is allowed to escape. It, of course, expands enormously, and is correspondingly cooled. This very cold air passes into the space between the inner and outer tubes, and finally escapes at F. The result of this is that the compressed air in the inner tube is soon cooled down so far that a considerable part of the air that escapes at D appears in the liquid form. This collects in the lower part of the jacket, and on opening the stopcock at E the liquid escapes in a stream the size of one's finger.

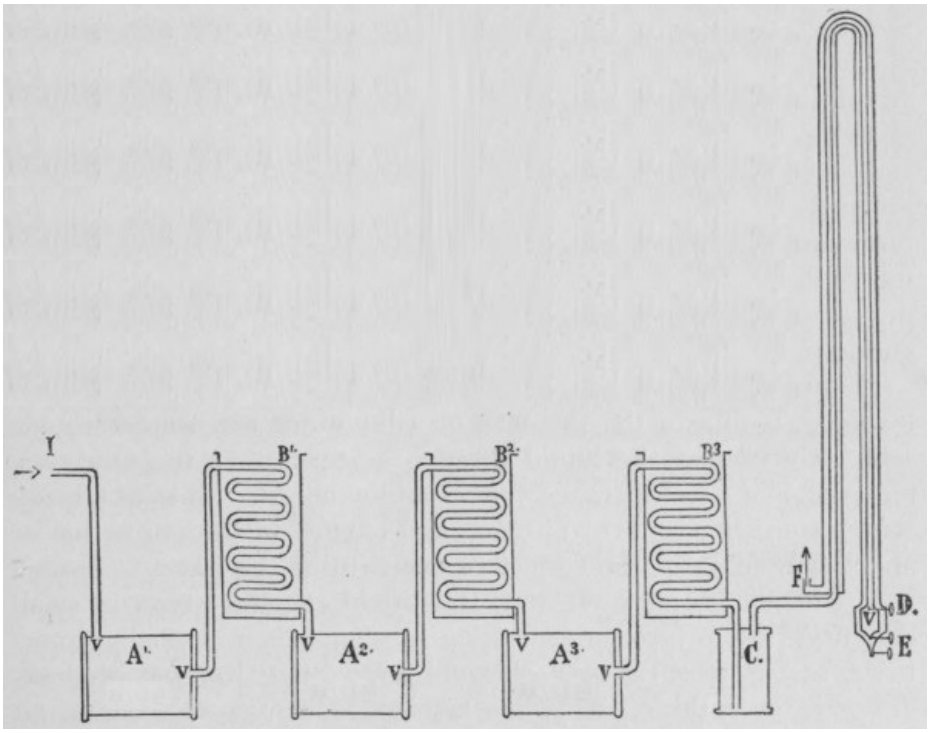


Fig. 2.—Diagram showing Working of Compression Apparatus for making Liquid Air.

In Mr. Tripler's laboratory the liquid is collected in the cans already referred to. Although for the reasons mentioned the evaporation of the liquid is comparatively slow, it is constantly going on, and as the gas formed occupies a very much larger volume under the pressure of the atmosphere than the liquid from which it is formed, it is necessary to leave the cans loosely covered. Otherwise the pressure would increase to such an extent as to burst any but the strongest vessels. One cubic foot of liquid air gives at atmospheric pressure eight hundred cubic feet of gaseous air.

Liquid air obtained as described is a turbid, colorless liquid. The turbidity is due to the presence of solid water and solid carbonic acid. By passing the liquid through a paper filter the solids are removed, and a transparent liquid is thus obtained. This, as already stated, consists mostly of nitrogen and oxygen in the proportion of about four fifths of the former to one fifth of the latter. Though it should not be forgotten that this liquid contains argon in small quantity, besides three or four other substances in still smaller quantities, as has recently been shown by Professor Ramsay, we may disregard everything except the nitrogen and oxygen. Liquid air is a *mixture* of these two substances. They are not chemically combined as hydrogen and oxygen are, for example, in water. This mixture boils at -191° C. (-312° F.), which is the temperature of the liquid as it is in the cans. As the nitrogen boils at a lower temperature (-194° C. or 318° F.) than oxygen (-183° C. or 297° F.), more nitrogen is converted into gas in a given time than oxygen, and after a [Pg 43] time the liquid that is left is much richer in oxygen than ordinary air. When liquid air is poured upon water it, being a little lighter than the water, floats, not quietly, to be sure, but in a very troubled way. Soon, however, the liquid sinks to the bottom because the nitrogen, which is the lighter constituent, passes into the gaseous state, and the liquid oxygen which is left is a little heavier than water. The experiment is a very beautiful one. A scientific poet could alone do justice to it. The beauty is enhanced by the fact that while liquid air is colorless, or practically so, liquid oxygen is distinctly blue.

Although liquid air has the temperature -191° C. (-312° F.), one can without danger pass the hand through it rapidly. The sensation is a new one, but it is evanescent. Very serious results would follow if the hand were allowed to remain in the liquid even for a short time. The tissues would be killed. So also, it is possible to pass the hand rapidly through molten lead without injury. In the latter case the moisture on the hand is converted into vapor which forms a protecting cushion between the hand and the hot liquid; while, in the former case, the heat of the hand converts the liquid air immediately surrounding it into gas which prevents the liquid from coming in contact with the hand.

When the liquid is poured out of a vessel in the air it is rapidly converted into gas. The great lowering in the temperature causes a condensation of the moisture of the air in the form of a cloud. The same thing is seen when the cover is removed from a can containing the liquid. Of course, this liquid does not wet things as water does. When, however, as happened in New York, the lecturer deliberately pours a dipperful of the liquid upon a priceless Worth gown, he may expect to hear expressions of horror from the owner. This experiment passed off most successfully. Every trace of the liquid air was converted into invisible gases before the fleeting agony of the sympathetic audience had passed away.

The effects of very low temperature upon a number of substances have been studied, and some of them can easily be shown. Paraffin, resin, and rubber immersed in liquid air soon become very brittle, and the color of the resin is completely changed. A beefsteak or an onion also becomes

brittle, and can be broken into small fragments by the blow of a hammer. A similar effect is produced in the case of some metals. Tin and iron, for example, become brittle, and the tenacity of the iron is greatly increased. A copper wire, however, retains its flexibility. At low temperatures the electric conductivity of all metals is increased. In general, the lower the temperature the greater the conductivity. If a copper wire could by any means be kept cold enough, electrical energy could be transmitted by it with but little loss—perhaps none. Mercury [Pg 44] is easily frozen by surrounding it with liquid air, and the solid thus formed is very hard, though if it is cooled down sufficiently it becomes brittle.

Alcohol can be frozen without difficulty by means of liquid air. By the aid of the lowest temperatures hitherto attainable it has only been possible to convert alcohol into a pasty mass. The frozen alcohol is as hard as ice. When alcohol is dropped into liquid air the drops retain the globular form. When taken out on a platinum loop the flame of a Bunsen burner does not set fire to it.

Phosphorescence is greatly increased by cooling substances down to the temperature of liquid air. This has been shown by means of water, milk, paper, eggs, and feathers. An egg and a feather could be distinctly seen in a dark room.

Scarlet iodide of mercury is converted into the yellow variety when it is subjected to the temperature of liquid air. Some other colors are changed under the same circumstances, but not enough is known of this subject to warrant a general statement.

Attention has already been called to the fact that liquid air loses its nitrogen more rapidly than it does its oxygen, and that, after a time, the residue contains a large proportion of oxygen. As combustion is combination with oxygen, combustion or burning takes place more readily in contact with this liquid oxygen than it does in the air. If a lighted match is attached to the end of a steel watch spring, and this then plunged beneath the surface of liquid air, the spring will soon take fire and burn brilliantly, the sparks flying off for some distance in beautiful coruscations. Hair felt, which does not burn in the air, burns in a flash when soaked with liquid air. Finally, when liquid air is confined in any vessel not capable of sustaining an enormous pressure, say about ten thousand pounds to the square inch, the vaporization goes on until the vessel bursts or the stopper is forced out. It might therefore be used as an explosive without any addition, but its manipulation is not altogether simple.

Now for the inevitable question: Of what use is liquid air likely to be? This is a perfectly proper question, and yet, if scientific workers always stopped to ask it, and would not work unless they could find a favorable answer, progress would, to say the least, be much slower than it is. Most great practical discoveries have necessarily passed through the plaything stage. Some of the most important discoveries have not even furnished playthings, and have found no practical applications as this expression is commonly understood. But the production of liquid air, while furnishing mankind with a beautiful and instructive plaything, seems likely to find practical [Pg 45] applications. We may look for these in four directions, to each of which a short paragraph may be devoted:

First, as a cooling agent. Low temperature is marketable. To be sure, the demand for the extremely low temperature that can be produced by liquid air does not exist to-day, but this concentrated low temperature can be diluted to suit conditions. The only question to be answered in this connection is, then, What is the cost of cold produced by liquid air? It is impossible for any one to answer this question at all satisfactorily at present. It can only be said that this is what experimenters are trying to find out. It appears, however, that they are on the way to cheap liquid air, and that as the processes are improved the price will become lower and lower.

Second, for the construction of motors. There is no doubt that liquid air with its enormous power of expansion can be used as a source of motive power just as compressed air is. In the case of steam it is necessary to heat the water in order to convert it into steam, and to heat the steam to give it the power of expansion. The cost is, in the first instance, that of the fuel. Given a certain amount of heat, and a certain amount of work is obtained. If liquid air is used, the problem is much the same. Engines must be run in order to compress the air which is to be liquefied. Every gallon of liquid air has been produced at the expense of work of some kind. Now, the question arises at once, What proportion of the work that was put in that gallon of liquid air in the course of its production can be got out of it again? It is certain that all of it can not be got out unless all that we have ever learned about such matters goes for nothing. In dealing with the problem of the application of liquid air as a source of motive power we are therefore doubly handicapped. In the first place, we do not know the cost of the liquid when produced on the large scale; and, in the second place, *we* do not know the probable efficiency of a liquid-air motor. I say "we do not know." Perhaps Mr. Tripler and the others engaged in the experiments on this subject do know approximately. We certainly can not blame them for not telling us all they know at this stage of the work. It is unfortunate, however, that such a statement as was recently published in a popular magazine should be allowed to gain currency—apparently with the sanction of Mr. Tripler. The statement referred to is to the effect that ten gallons of liquid air have been made by the use of three gallons of liquid air in the engine. If that means that the ten gallons of liquid air are made from air at the ordinary pressure, the statement is in direct conflict with well-established principles. If it means that the ten gallons of liquid air are made from air that has already been partly compressed, we must know how much work has been done before the liquid-air engine began. Leaving out of consideration the question of cost, it may be pointed out that [Pg 46] liquid-air engines would have the advantage of compactness, though they would necessarily be

heavy, as they would have to be strong enough to stand the great pressure to which they would be subjected.

The third application of liquid air that has been suggested is in the preparation of an explosive. In fact, an explosive has been made and used for some time in which liquid air is one of the constituents. When the liquid from which a part of the nitrogen has boiled off is mixed with powdered charcoal, the mixture burns with great rapidity and great explosive force. "To make this explosive, Dr. Linde pours the liquid containing about forty or fifty per cent of oxygen on fragments of wood charcoal, two or four cubic millimetres in size. These are kept from scattering under the ebullition of the liquid by mixing them into a sort of sponge with about one third of their weight of cotton wool." Of course, this explosive must be made at or near the place where it is used. It has been in use in the way of a practical test in a coal mine at Pensberg, near Munich. It is claimed that the results were satisfactory. The chief advantage of the explosive is its cheapness, and the fact that it soon loses its power of exploding.

Finally, the fourth application of liquid air is for the purpose of getting oxygen from the air. This can be accomplished by chemical means, but the chemical method is somewhat expensive. Oxygen has commercial value, and cheap oxygen would be a decided advantage in a number of branches of industry. It will be observed that it is the liquid oxygen that makes possible the preparation of the explosive described in the last paragraph. Oxygen as such in the form of gas is of value in Deacon's process for the manufacture of chlorine. In this process air and hydrochloric acid are caused to act upon each other so as to form water and chlorine. The nitrogen takes no part in the act, and it would be an advantage if it could be left out. It is only the oxygen that is wanted. There are many other possible uses for oxygen either in the liquid or in the gaseous form, but these need no mention here.

In conclusion it may safely be said that it is highly probable that liquid air will be found to be a useful substance, but it is impossible at present to speak with any confidence of the particular uses that will be made of it. As work with it is being carried on energetically in at least three countries, we may confidently expect important developments in the near future.

THE PHYSICAL GEOGRAPHY OF THE WEST INDIES.

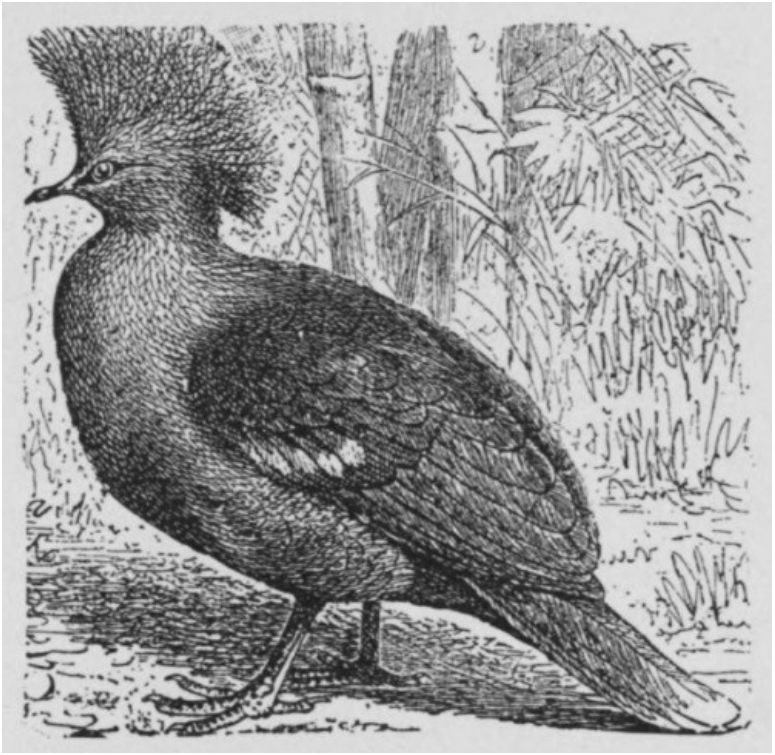
[Pg 47]

By F. L. OSWALD.

II.—BIRDS.

The abundance of birds on the four largest islands of the West Indian archipelago, where indigenous mammals are almost limited to rodents and bats, has often suggested the conjecture that the ancestors of those islanders must have been immigrants from the east coasts of the American mainland; and that theory seems to be confirmed by two facts: the identity, or similarity, of numerous Mexican and West Indian species, and the circumstance that those analogies include so many swift-winged birds.

There are no woodpeckers in the forests of the Antilles, and only two species of large gallinaceous birds, but a prodigious variety of pigeons, swallows, finches, and crows. The *alcedos* (kingfishers) are scarce, but the blackbirds so numerous that some of the countless species seem to claim a South American and even transatlantic ancestry. The restless *estornino* of the Cuban highland forests, for instance, might be mistaken for a varnished starling, resembling the *Sturnus vulgaris* of western Europe in everything but the more brilliant luster of its plumage. The curious *codornilla*, or dove quail, too, has its nearest relatives on the other side of the Atlantic, in Syria, Arabia, and the foothills of the Atlas. It builds its nest on the ground and, judging from its appearance, would seem to form a connecting link between the doves and small *gallinæ*; but its wings are those of a pigeon, and with the assistance of a northeast gale may possibly have carried it across the ocean.



Crown Pigeon.

In studying the geographical distribution of animals, we may estimate the prevalence of special genera by the number of their varieties, or by the aggregate sum of individuals, and in the latter sense the migratory pigeons of our forest States once nearly outnumbered all the other birds of North America, though the family is limited to five or six species. But in the West Indies the *Columbidæ* predominate in both respects. Cuba is a country of wild pigeons as pre-eminently as South Africa is a land of pachyderms and Madagascar of night monkeys. The *Columba leucocephala* (a congener of our ringdove) inhabits the mountain forests in countless swarms, and at the end of the rainy season visits grainfields in such numbers that hundreds are sometimes captured in nets, by means of corn scattered along the furrows. [Pg 48]

A closely allied variety is found in San Domingo, where in many upland regions a darkey, equipped with a shotgun and a supply of gunpowder, can dispense with agriculture and raise a family of anthropoids on pigeon pies and *tortillas*, compounded from the grain found in the crops of his victims.

But the *tittyblang* (*tête-blanc*) has scores of smaller and larger cousins, culminating in the Cuban primate of the family, the splendid *paloma real*, with its coronet of pearl-gray plumes and dark-blue wings.

Ducks, too, must number some twenty West Indian species, and one kind of wild geese often obliged the rice planters to employ mounted sharpshooters, who galloped up and down the long dikes, yelling blasphemies, and every now and then enforcing their quotations with a handful of buckshot. But, for all that, the planter could think himself lucky to gather a sixty-per-cent harvest of the total produce, for experience soon enabled the long-necked depredators to estimate the target range of the *cazador* within a dozen yards and take wing in the nick of time, only to resume their feast at the other end of the plantation.

A long-continued process of natural selection has also modified the habits of numerous species of West Indian parrots. Four hundred years ago, when Fernan Oviedo superintended the placer mines of Hayti, *loris* were so abundant and tame that his assistants often amused themselves prowling about a thicket of berry bushes and capturing the chattering visitors by means of a common ring net. Nestlings could be taken from every hollow tree, and often from the thatchwork of deserted Indian cabins; but the overconfident specimens came to grief, and the survivors have learned to give the Caucasian varieties of the *Simia destructor* a wide berth. They raise their young in the cavities of the tallest forest trees, and approach human habitations only at dawn of day and sometimes during the noonday heat, when creoles can be relied upon to indulge in a *siesta* nap. In reliance on their protective colors, gray parrakeets frequent the dead timber of the coffee plantations, while the leaf-green Amazon parrot sticks to leaf trees. [Pg 49]

"When they alight on a dry branch," says Captain Gosse, in his Jamaica chronicle, "their emerald hue is conspicuous and affords a fair mark for the gunner, but in a tree of full foliage their color proves an excellent concealment. They seem aware of this, and their sagacity prompts them to rely on it for protection. Often we hear their voices proceeding from a certain tree, or have marked the descent of a flock, but on proceeding to the spot, though the eye has not wandered from it, we can not discover an individual; we go close to the tree, but all is silent; we institute a careful survey of every part with the eye, to detect the slightest motion, or the form of a bird among the leaves, but in vain, and we begin to think that they have stolen off unperceived, but on throwing a stone into the tree a dozen voices burst forth into cry, and as many green birds dart forth upon the wing." [Pg 50]

Porto Rico Parrakeet.

The gorgeous macaws, on the other hand, seem to owe their color contrasts to sexual selection. "Ya son vencidos los pavos de India"—"That does beat a Hindostan peacock"—exclaimed King Ferdinand, when Columbus introduced those most splendid products of the American tropics.

Nor can the exigencies of protection have evolved the glaring colors of the West Indian hornbill. The *toco* (toucan), as the Cubans call the yellow-billed species, can be descried from a distance of two hundred yards, and is, indeed, not anxious to be admired at close range. Old specimens get as wary as mountain ravens, but, like crows, become ridiculously tame in captivity, and will follow their proprietors with loud croaks, every now and then opening their lunch-trap to indicate their desire for refreshment. They are, on the whole, the hardiest of all tropical birds, and can weather the winters of our coast towns as far north as Wilmington, in open-air cages, owing perhaps to their habit of extending their excursions to the high mountain ranges of their native land.

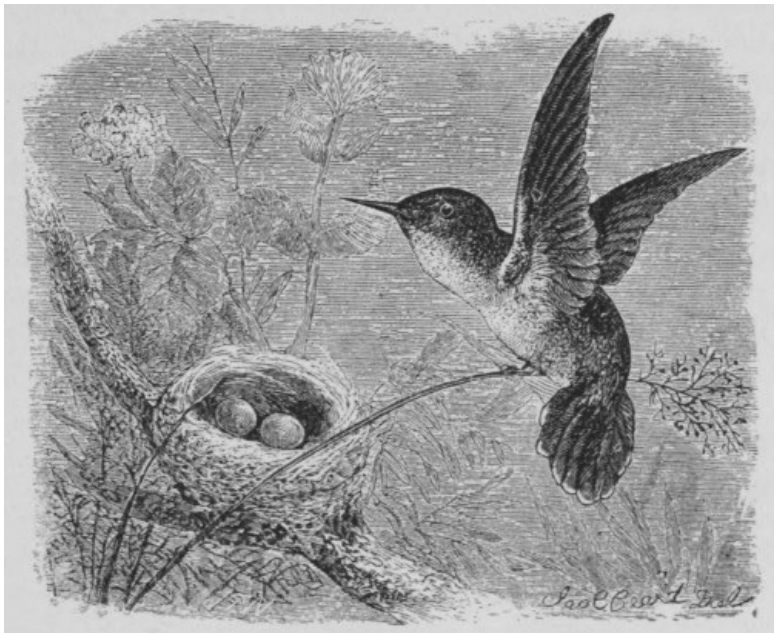
Economical Nature rarely wastes the gift of song on a bird of bright plumage, but it is less easy to understand why so many feathered beauties should have been afflicted with harsh and positively repulsive voices. The horrid screams of the peacocks, guinea hens, and macaws can hardly be supposed to charm their mates, and are too easily recognized to deter their natural enemies. But the roars (there is no more adequate word) of some species of hornbills would almost seem intended to serve the latter purpose.

"The voice of the *Buceros bicornis*," says Wallace, "can [Pg 51] be plainly heard at a distance of a mile, so that the amazement of travelers visiting its haunts seems explicable enough. Its screams may be described as something between the bray of a jackass and the shriek of a locomotive, and are not surpassed in power by any sound that an animal is capable of making. They re-echo through the hills to such a degree that it is difficult to assign the noise to a bird, and are sometimes kept up so continuously as to become absolutely unbearable."

The condor and the harpy eagle have not found their way across the Caribbean Sea, but the West Indies boast three varieties of fish eagles, several species of mountain falcons, and a curious singing owl, the *oriya*, that chants its serenades in the plaintive strain of the whip-poor-will, and is dreaded by the Porto Rico darkeys as a bird of ill-omen:

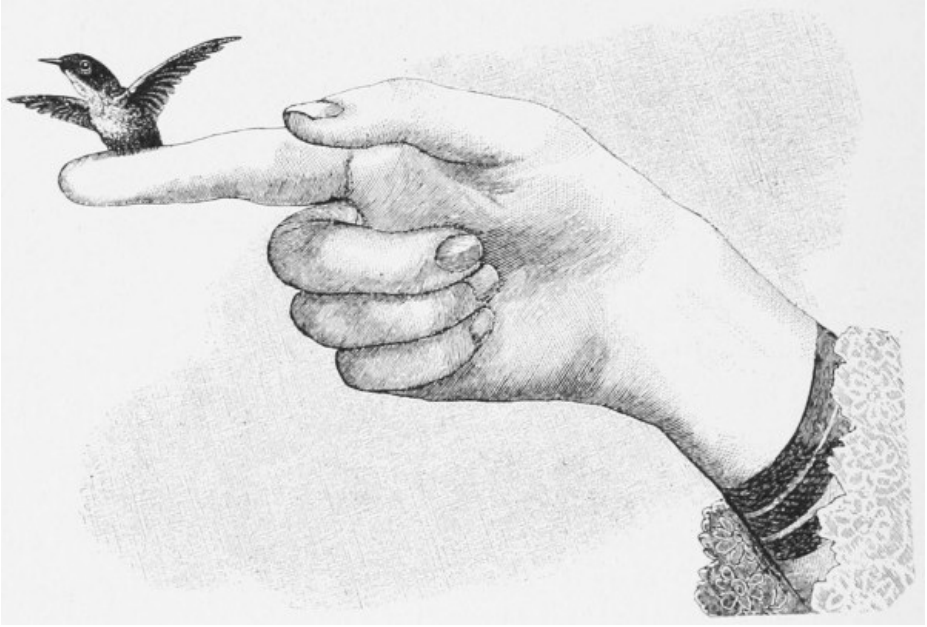
> "Grita l'oriya: Venga amigo,
> Venga conmigo a mi patria,
> Venga te-digo!"

Small hooting owls abound, and there are four species of sparrow hawks, one of them not much larger than a finch.



Vervain Humming Bird and Nest.

It is probably the smallest bird of prey, and there is no doubt that one species of West Indian humming bird is the smallest bird on earth, the *Vervain colibri*, of Jamaica, that hides its nest under an orange leaf, and, though an insect-eater, could be easily overpowered by an able-bodied bumblebee. In beauty some of the south Cuban species rival those of the Amazon Valley, and frequent every flowering shrub from the jungles of the coast lands to the highland meadows of the Sierra Maestra. In Hayti there are parklike plateaus where they often appear in swarms at a time of the year when the forests of the foothills are drenched by the afternoon cloudbursts of the rainy season, and on some of the smaller Antilles they are seen only during the flowering period of special plants.



The Smallest Bird.

In the solitudes of the Morne Range (San Domingo) mountain ravens rear their brood in the crevices of steep rocks, and fiercely attack birds of prey, not excepting the black-crested eagle, that now and then visits the sierras in quest of conies. But the winged constables of the highlands rarely leave their mountain reservation. Of Abd-el-Wahab, the Arabian heretic, it used to be said that "Mohammedan zealots shrank in affright from his superior fanaticism," and on the midway terraces of the Dominican sierras the persecution mania of the giant crow yields to that of the great shrike, the *Lanius rufus*, that operates pairwise and assails all winged comers with absolutely reckless courage.

The raven of the Mornes seems to be identical with the cosmopolitan forager that is found in the uplands of the eastern continent from the bleak summit regions of the Hindu-Kush to the sierras of Portugal, and from the Atlas to the Norwegian Alps; but there are several exclusively West Indian species of the genus *Corvus*, including a steel-blue rook that flits about the Cuban coffee plantations and has a curious habit of perching on a stump and talking to itself in a sort of croaking chuckle for half hours together.

Crested Curassow.

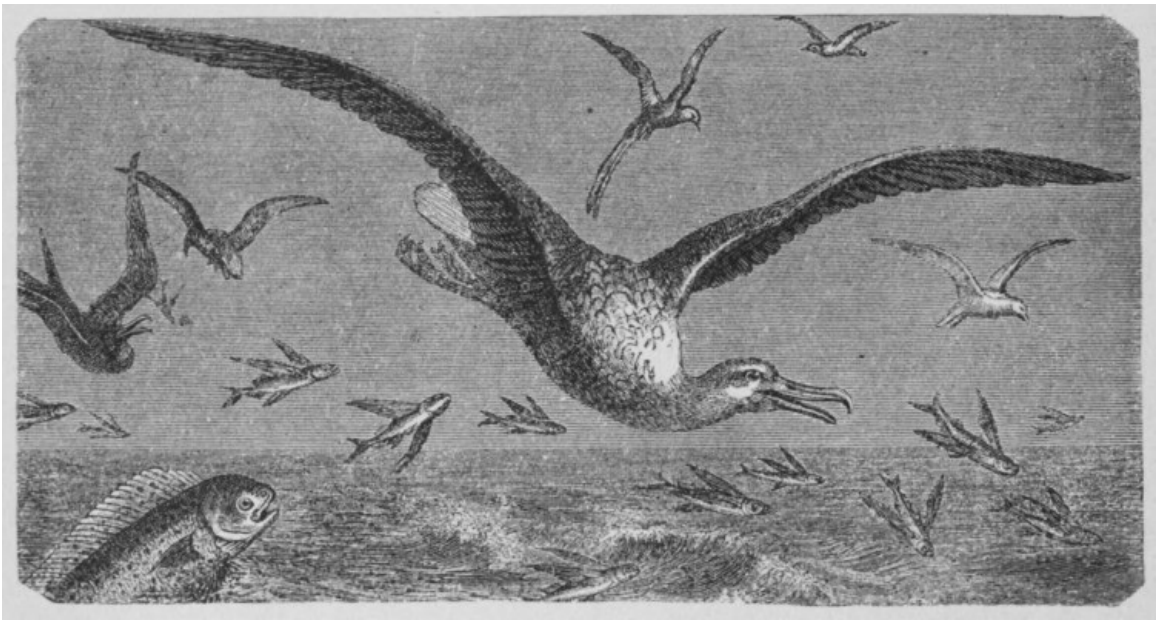
[Pg 52]

The *gallinæ*, as might be expected from their limited wing-power, are well represented in the number of individuals, rather than of species. Turkeys, though abundant in the coast forests of Central America, are not found wild in any part of the West Indies, where the perennial presence of berries would be as inviting as the absence of foxes.

In the mountains some species of curassow have, however, developed into a stately game bird, the *Oreophasis niger*, or highland "pheasant," that lays a dozen large eggs, and in its courtship season becomes so infatuated that it can be approached and killed with a common walking-stick. The consequent persecution has made it rather scarce in famine-stricken Cuba, but in Hayti it can still be seen in troops of a dozen or more, scratching up the dry leaves of the sierra forests, or pecking at insect-haunted shrubs, exactly like a flock of Tennessee turkeys.

There are also several varieties of true pheasants, and two species of quail (besides the above-mentioned *codornilla*), and in eastern Cuba numerous barnyard chickens have taken to the woods

and become so shy that it seems a puzzle how their ancestors in the coast range of Burmah could ever be captured and domesticated. They still practice polygamy, combined with a system of co-operative housekeeping, to judge from the number of eggs that are often found in one nest. At [Pg 53] the approach of an unfeathered biped the hen bird takes wing with a screech, and is apt to vanish for the rest of that day. The roosters are rarely seen, their glaring colors having faded into more protective shades of olive and brown, but at dawn of day their shrill reveille can be heard from afar in the heart of the pathless jungle woods.



The Caribbean Albatross.

[*To be continued.*]

INSANE CHARACTERS IN FICTION AND THE DRAMA.

By Prof. CESARE LOMBROSO.

One of the things that most strikes one who compares the ancient theater, and even the theater of a few years ago, with the modern theater, is the enormous difference in the character of the personages, and particularly the curious frequency of insane as principal personages in the modern theater. We have come to such a point that one may be almost sure that in reading over a new play, by Ibsen, for example, he will find three or four insane personages in it, if, the characters are not all so. These madmen have characteristics so particularized as to seem as if they might have been depicted by an alienist. If the protagonists are not mad, they are agitated by such violent and strange passions as the ordinary world never meets in life; which it therefore refuses to accept when they are described in a scientific book, but nevertheless receives them when it sees them in the scenes or meets them in the romances of the great modern novelists.

Ibsen, for example, has made a most exact picture of the progressive general paralysis which arises, precisely as he depicts it, in men of genius, of great mental activity, who have wasted their hereditary power in pleasures or excessive work; and there is in them both impulsiveness and want of will power, complete perversion of all the instincts, and mental confusion, alternating here and there with genial flashes; but he is wrong in accumulating in a single subject the maladies of a large number of diseased, and therefore exaggerating their eccentricities—as he exaggerates atavism and heredity of disease when he makes the morbid son repeat the same incoherent phrases as the father from whom he inherits his disorder used.

Just and true, however, is that other form of heredity under which from a father corrupted by licentious indulgence and by alcohol, and criminally vicious, is born, besides a paresic son, a lascivious and criminal daughter, who throws herself into prostitution at the first opportunity without any special cause.

So, too, that love of art existing now as only a dream, and that egotistic good nature which enjoys [Pg 54] the advantages of a mother's care without gratitude, those short accesses of genial eloquence followed by fury which burst out from the midst of apathy, and which are drowned in the intoxication of alcohol with a complete, immediate forgetfulness of everything, are specific traits of paralytic dementia.

Ibsen, in Hedda Gabler, describes to us a neurotic woman who, being pregnant, and therefore suffering more acute attacks, avenges herself, though married, upon her former lover, who had left her, by burning the manuscripts which he expected to make him famous. Virile, like all criminals, she nursed her resentment from youth.

In the Pillars of Society the great political characters are rogues and neurotics.

In Berkmann the true criminal banker comes into play. He does not kill or ravish, but appropriates the money belonging to his bank under the illusion that he will be able to make great gains with it through the accomplishment of wonderful things that will secure to him his single joy—power; and that he can then restore the sum with redoubled interest.

This case is of a kind of very frequent occurrence, and shows a complete absence in the banker of affection and of moral sense. He sacrifices the woman who loves him to further the desires of an accomplice. He has a faithful friend who, robbed by him, continues to visit him every day and give him the solace of admiration even when all despise him; and he repels him when he fails to absolve him and to believe in the possibility of his return to power. Later the defaulter pretends that he has studied his own case, and has probed it in every way, with the result of a complete acquittal of himself. And why all this? Because he has used the money of others for great purposes: to connect seas, to excavate the millions that are shut up in the bosom of the earth and are crying out to be brought into the light. Thus it is that with the combined genius and delirium of megalomaniacs he hears the call of the minerals and the groaning of the ships longing to be set free. Conscience, duty, and probity do not exist for him. He believes that his quality as a man of genius permits him everything; therefore he sacrifices to his chimeras the beings who love him most. "I am," he says, "like a Napoleon disabled by a shot in his first battle"; and he does not perceive that he has grown old, that he has a mortal heart disease; and he dreams of returning to power and of hearing men ask the benefit of his advice, and no longer talks with anybody, because there is nobody but his old lover who does not believe him guilty.

Finally, repulsed by all, he plunges into the whirl of life and the torment of the mountain, and dies at last of syncope; while his equally egotistical son deserts the mother who adores him to go to the south with the wealthy Amasia, daughter of his father's enemy. [Pg 55]

In Dostoievski, madmen, especially epileptics, constitute the absolute majority of the characters; or else they are born criminals, such as my school has attempted to identify by the figures on the hand.

"This strange family," he writes in The House of the Dead, "had an air which attracted notice at the first glance." All the prisoners were melancholy, envious, terribly vain, presumptuous, susceptible, and formal in the highest degree. Vanity ruled always, without the least sign of shame or repentance or the least sorrow over the commission of an offense. Nearly all the convicts dreamed aloud or raved during sleep. Most usually they spoke words of abuse and slang, talked of knife and axe. "We are a ruined people," they said; "we have no bowels; therefore we cry out in the night."

This impossibility of feeling remorse or penitence, along with vanity and exaggerated love of pomp, are characteristics well known to all observers. But other traits were manifested perhaps more conspicuous, and such as are common to children. On feast days the more elegant ones dressed gorgeously, and could be seen parading themselves through the barracks. Pleasure in being well dressed amounted to childishness in them.

Reasoning has no power upon men like Petroff, because they have not any decisive will. If they have, there are no longer obstacles to it. Such persons are born with an idea that moves them unconsciously all their lives hither and thither. They are quiet till they have found some object that strongly arouses their desire; then they no longer spare even their heads. "More than once have I wondered to see how Petroff robbed me in spite of the affection he had for me. This happened to him at intervals, when he had a strong desire to drink. A person like him is capable of assassinating a man for twenty-five soldi, only to drink a litre; on other occasions he would scorn thousands of rubles. He often confessed his thefts to me, lamenting that I no longer had the objects, but showed no penitence for having stolen them; bore reproofs because he thought they were inevitable, or because he deserved to receive them; because I ought to punish him to compensate myself for the things I had lost, but thought within himself that they were trifles that one ought to be above speaking of."

Further on the novelist speaks of the smuggler by profession, a pleasant fellow, condemned for life for his offenses, who could not lose the instinct for smuggling brandy into the prison. He received only a ridiculous profit, was greatly afraid of the rod, although he had rarely passed under it, wept, swore that he would not offend any more, and then fell down.

Zola also reproduces my epileptic moral madman in *La Bête Humaine*, in the alcoholic in *L'Assommoir*, the paranoiac in Work, and himself confesses to having taken the brief of his immortal chain of romances, Rougon, from a study made by Aubry in a provincial family celebrated for its richness in degenerates, criminals, and insane, all derived from a dull, neurotic Keratry. [Pg 56]

Daudet depicts in Jack a series of *mattoidi*, that particular species of insane which I first discovered, that occupies a position between paranoiacs, geniuses, and imbeciles.

Ancient Romance and Theater.—We turn now to the ancient theater and romance. All the Roman novels of Petronius and Apuleius are rich in obscene, mythological, and magical adventures, most improbable and satirical, without ever defining a character or including a real madman.

In the ancient Greek theater, while the idea of heredity is discernible under the form of fate, while violent passion is every now and then depicted under marvelous forms, while anomalies strike us, and furies of Ajax and Dejanira, of Orestes and Œdipus, and the melancholy of Philoctetes, they all still have a common type, which is not perceived in ordinary life. They are

madmen who do not exist in any asylum, who seem symbolical, and have little correspondence with the men of the mythological and heroic epoch to which they all belonged; they never, except in Euripides, present a specific personage, nor ever, unless with rare exceptions—as in the Persians of Æschylus and a few other lost works, like the Siege of Miletus—deal with contemporary historical facts.

These poets were concerned with the symbol, the moral, the tradition, and, if I may be permitted the term, the blasphemy, the declamation, rather than with depicting the person. This is further seen in the comedy of the Greek decadence, and still further in that of the Romans, in which, except in the political squibs, the same personages nearly always appear, as well as showing out of the masks intended for the common people—and these figures have come down to us. There are nearly always the old miser or rake, the go-between slave, the braggart soldier. The plots were likewise the same: changed children, reconciled lovers, except in the Greek political satires, in which the demerits of the adversary were exaggerated into the most atrocious caricature, and which became like real humorous journals of the political trifles of the day.

Yet these highly cultivated peoples, agitated by grand public passions, had absorbing, moving controversies—the struggles of the Gracchi, the banishment of Themistocles and Aristides, and the varying fortunes of Marius, of which no trace is found. Nor, for the rest, did the Latins, who were our masters, and were, as we are after them, copyists, followers in the footsteps of their [Pg 57] Greek predecessors, readapt contemporary events to their dramatic lines. We in our turn, down to Goldoni and Molière, and even to this very century, have copied those ancient comic and tragic writers, warming them up afresh from Orestes and Clytemnestra, and from events which had not the least echo among us. Trissin, Maffei, and Alfieri delineated more or less, on one side tyrants, on the other tyrannicides, which have little to distinguish them from one another. So in Schiller and Goethe, all the passions are of the scene rather than of personages. Thus Faust, for example, and Margaret, are not persons who have a special character. They are, in fact, personages who cover a symbol, who would tell the story of literature, the story of the beautiful, the skepticism of knowledge, but they tell it with a number of interesting, moving facts, without delineating an individuality. Faust is neither very good nor very bad, since he with his easy way of speaking commits rogueries of every kind till finally he is redeemed. He is a scientific student with a passion for investigation, but in his enthusiasm, instigated by the devil or by doubt, he too often deserts the search for the truth for that of pleasure, too often forsakes the studies that had ennobled his life from youth, and as a man to enjoy the nights of the Brocken, and worse, the favors of Margaret, of Helen, till the moment when he redeems himself by saving a people; but he does this at the last instant, when he is about to die, and has nothing more to enjoy. Margaret, too, is a child like other children, who, like so many others, suffers herself to be beguiled by manly beauty, and has no good qualities except that of being able to die with fortitude, hoping with the penalty to expiate the sin, which is, in fact, more the devil's than hers.

The elder Dumas invented an immense diverting confusion of facts, but his personages are always the same, and are the occasion, the instrument, the setting of the adventures.

The Reasons for this Absence.—The inquiry into the reasons of this absence of insane persons in the older romances and dramas is a curious one. The first cause lies evidently in the law of proceeding in every organism as in every work from the simple to the complex. As in penal law, not the criminal but the crime was studied at first, while now both are studied together; as in primordial medicine only the disease was studied, while now the patient is studied first of all; so in the drama and in comedy, in the measure that the thought has become discriminating, it has substituted or rather associated with observation of the fact *per se*, that of the author of the fact. The study, of course, exacts more acumen, but it also better satisfies our reinvigorated culture and opens broader horizons to us.

We have thus done more than abandon the pedantesque scale of the old time and the mere study [Pg 58] of the fact; we have introduced characters into the personages, which, while they correspond to living and real characters that we have under our eyes, attempt to resolve a problem and teach us a moral, and go so far as to represent to us a symbolical idea which is a pure abstraction of the author's, reaching thence the maximum of complication.

Naturally, such salient characters as madmen, eccentrics, and criminals would not be likely to escape the notice of the dramatist, who finds in them motives for great effects without departing from truth and probability.

But there is another more material reason for the recent introduction of insane characters into the theater, and for their greater frequency and participation in real life. It has been remarked that insane persons have multiplied a hundredfold with civilization, to such an extent that where a few years ago one madhouse was enough, now five hundred and six are needed. Taking, for example, the statistics of the most progressive country in the world, those of the United States, furnished by its invaluable census report,[17] we see that the number of insane persons, which was 15,610 in 1850, 24,042 in 1860, and 37,432 in 1870, rose in 1880 to 91,994; while the population, from 23,191,876 in 1850, increased to 38,558,371 in 1870, to 50,155,783 in 1880—that is, while the population doubled in a little more than thirty years, the insane increased sixfold; so, in the last decade the increase in population was thirty per cent, and that of insane one hundred and fifty-five per cent.

In France[18] there were 131.1 insane per 100,000 inhabitants in 1883, 133 in 1884, 136 in 1888. These figures indicate that the number of insane is larger in the most civilized countries, and is

increasing every year. It may indeed be said that many of these insane are not produced but are only revealed by civilization, and that the opening of the large asylums has caused a considerable number to be brought into the light who were not known of before. It is true that the greater care we give now to the insane, as well as to consumptives, makes them longer-lived. And it is true that as the mind grows enlightened criminals come to be regarded as insane and thus increase the apparent number of such. But all this is not sufficient to explain a doubling in a decade, a tenfold increase in twenty years.

We know, too, that civilization has brought on the development of new forms of disease, which [Pg 59] hardly existed before. For example, general progressive paralysis was formerly so rare that no special name was given to it till our time, while now it forms the larger quota of the maladies of the wealthy, of thinkers, and of military men. Epilepsy has greatly increased in its psychical form, so that what are called psychical and obscure epilepsy are a revelation of our times, and that its close association with crime (which I believe to be one of the sure facts of modern psychiatry) is still accepted by only a very few alienists, not to say that it is rejected with indignation, and, I will remark, with profound ignorance, by most modern jurists.

Alcoholism, too, has taken on enormous proportions. Not that the ancients did not drink, but rather that pure alcohol had not yet been introduced; while in the middle ages it passed for one of the most efficacious remedies—*aqua vita*, living water. Dr. Beard has made a most judicious observation in America which I have been able to verify in Sicily—that there must be a very advanced degree of civilization, or rather of degeneracy produced by civilization, for inebriety to be transformed into that aggregation of disasters, especially of the nervous system, which is called alcoholism. Now we have not alcoholism only, but morphinism, cocainism, all stimuli of the nervous system, which are used by barbarians as potent excitants, but not to the point of producing stable alterations except in rare cases, like the *amuck* of the Malays.

And now, we all of us, at least in the capitals and the great centers, find ourselves consumed by a feverish activity which makes the mind labor much more than Nature intended it should, under which is produced all this mass of neurasthenics, hystericals, besides the multitudes of moral insane, profoundly egotistical persons, without affection and wholly directed by a powerful passion for gold, for which they sacrifice everything, even salvation!

And, finally, we have that group of semi-insane, which I call *mattoidi*, and who are known as *détraqués* in France and *cranks* in North America—that is, those who have the livery of genius with a substratum of weakness and the practical cunning of the average man, who betray their errors only when they write, who hardly exist save among males (with a few exceptions, like Michel) and in the great centers. I have never seen them in the country. Civilization is now depopulating the country and building up the cities, as it is also augmenting physical excitants with alcoholism, morphinism, etc. Civilization emblazons the baton of the marshal, and not only of the marshal but of the president of the republic, in the eyes of everybody who can read and write. Why, then, should we not suppose that civilization can further derange the equilibrium of mental labor and, indirectly, therefore cause an increase of insanity?

Not only has the number of insane increased, but their importance in society has multiplied [Pg 60] fourfold; for which reason we can not fail to give them attention. The morally insane in politics and the megalomaniac insane in the bank who inspired Ibsen are to be found walking around in every country. The blood-criminal, transmuted into the forger and the bankrupt, penetrates into our houses, and we suffer from him every day; while the insane man at first was not regarded, or was adored under the form of a saint or hated as a wizard, possessed of the devil always, or seemed a phenomenon strange to society, a species of extraplanetary meteor. If we add that the degeneration provoked by the abuses of civilization has begotten a multitude of forms akin to madness which afford a field for combinations now tragic, now strangely comic—like the phobia by which one is afraid to cross a room, or avoids a certain group of words, or refuses to know how many doors and windows there are on the street, or can not be at ease without saying sexual pacifying formulas; a class who with their perverted tastes form a real new world apart; and they all may inspire new dramatic settings forth.

As a third cause we add that in our age psychology has penetrated into all departments. There are psychologies of the senses, of the sentiments, of the will, the psychology of the crowd, of the insane, of criminals, and finally the psychology of the cell, or at least of the infusoria (Binet). Therefore, as statistics is applied to history, to politics, to religion, in the same way psychology has at last entered into romance and the drama, and has taken the lion's share. And, far from being repelled by the public, the authors who use it or abuse it, like Euripides and to a certain point Shakespeare, win the admiration of the public; and we are proud to see Zola taking from *L'Uomo delinquente* the Jacques of his *Bête humaine* to make an immortal figure of him, and Dostoiewski depicting innate criminals in his House of the Dead, and the criminaloid in his Crime and Punishment; and we do not despise Bourget when, making more a caricature of psychology than a psychology, he assumes to apply it to the toilets of women and the Parisian *cocottes* under the form of a psychology of love.

It may at first sight seem a contradiction that we have shown that there were also found in antiquity at great intervals dramatic poets and romancers like Shakespeare, Dante, and Euripides who, led by the observing and creative instinct, did not confine themselves to events, but studied characters too, and, keenly perceiving the dramatic potencies in the character of insanity, treasured it up in their works. Thus Euripides depicts Helena, vain even into her old age, saving a part of the hair she was offering at the tomb of her sister so as not to lose what remained of her

former beauty; and Orestes has not the simple bestial fury depicted by Æschylus, but has choreic movements, genial intervals, and a tendency to suicide, which show that the author had attained a true conception of the maniac. [Pg 61]

In the Mahabharata the maiden Damaianti is described as made insane by love (Book II, st. iii) and Nalo, who, possessed by the demon Kali, stakes his kingdom on the dice, and, denying his wife, abandons her in the wood:

"And with soul slave to the thought, discolored face, and all absorbed in sighs, now lifting up the head, now musing, bereft of sense, you would say; a sudden pallor came on. With mind occupied with one desire, nor sleep, nor the table, nor the sight of familiar friends afforded pleasure, nor day nor night gave repose. Ah! poor miserable one! thus exclaiming and bursting into tears, by that lament, by those soul-sick acts, she was recognized by her friends."

Niceforus has shown how Dante in his Inferno has delineated in the damned the characteristics which my school gives to the born criminal. Shakespeare has done better, and has divined many criminal characteristics through the greater intensity of the crime in the criminal woman. Virile even when compared with the criminal man, Lady Macbeth is crueler than her husband, and, more than that, has many of the characteristics of men:

> "Bring forth men-children only,
> For thy undaunted mettle should compose
> Nothing but males."

And Macbeth, as cool in the crime as the artful contriver of it, is hysterical and hypnotic, and in the accesses reproduces the acts and words of the tragedy, showing that the author knew that hysterics and somnambulists often repeat the acts and the emotions which mark the climax of their malady.

Hamlet has the folly of doubts and hallucinations, simulates the ravings of a madman, but in his suspicious cunning discovers and anticipates what is contemplated to his harm, is homicidal through fear, and is yet often discreet, and a good lover, save that his love vanishes before the fixed idea.

In Ophelia, disappointed love, the contact with a madman or a pretended one, the death of her father almost under her very eyes, provoke a species of madness which would now be called mental confusion, with vague ideas of persecution, dim recollections of love betrayed and of her father, incoherent and confused expressions ending in automatic suicide. This confirms our conclusions.

Genius has also anticipated an epoch in the use and abuse of lunatics, just because time is canceled for genius, because genius anticipates the future work of centuries. But on this subject the inquiry is pertinent why, while in the complaisant literary world such creations as the Argenson of Daudet, the Jack of Zola, and the Eliza of Goncourt find, if not an immediate, a kindly and ready acceptance—while all the great artists, even the most ancient ones, have given the type which I assign to the born delinquents to executioners and criminals—the world has refused to accept the existence of the criminal type of insanity in genius, and the relations in criminals between epilepsy and crime which are nevertheless received in romance and the drama. It is because when we are in the presence of true figures, made to move before us under a strong light by the great artists, the consciousness of the truth which lies dormant in all of us, smothered and broken under distortion by the schools, reawakens, and rebels against the conventional forms which they have imposed; all the more so because the charm of art has vastly magnified the lines of the truth, has rendered them more evident, and has thus much diminished the effort required to master them. If, on the other hand, we base our conclusion upon cold statistics and what I should call a skeleton study of the facts, we find the old views rising in confusion with those of sentiment and the artistic sense, and we arrive at nothing. [Pg 62]

COLONIAL EXPANSION AND FOREIGN TRADE.

By JACOB SCHOENHOF.

Fifty years have elapsed since the adoption of free trade by England. It was hoped that the free entrance of commodities extended to all the world would pave the way to an era of mutual peace and good will. But, judging by the political situation, and taking the armaments as an outward sign of good intentions, the era of peace and good will among nations is certainly far off. To get a trading advantage here and a concession from a semibarbarous country there is still the ambitious striving of the cabinets and the diplomacy of Europe. To give the striving emphasis, industry is taxed to the breaking point and labor to the starving point. Russia exhausts her resources in a railroad through the Siberian waste in her endeavor to obtain an outlet to the sea, which is jealously closed to her at the southwestern end of her dominions by England. The trader of Manchester, fearing for his markets, grows frantic at the prospect of Russian cotton goods being brought to China or to India. The mere acquisition of a port in Manchuria by Russia threatens to seal his doom. But he might look on with complacency. Russia's labor is very dear, capital is dear, wages are on the Asiatic level, famine still stalks through the land,

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intercommunication is made difficult by the lack of roads, and her wonderful natural resources lie unimproved because the eyes of greed, like those of the dog crossing the stream, are turned on the coveted piece of meat he sees reflected in the water, and to grasp which he drops the one he holds in his mouth. France bristles with bayonets, and is constantly at pains to increase her naval armaments, about whose seaworthiness her own minister of marine expresses suspicions, in obedience to a nervous restlessness for foreign acquisition. England, after her feat in civilizing savages and barbarians in the customary fashion, shown again at Omdurman, is ready to turn her war dogs on France, because the latter has the temerity to demand a slice of Soudanese territory. Well might she have given as hush-money, or for the mere grace of the action, a few thousand square miles of a country closed to access except by the permission of Great Britain, which has successfully pre-empted every desirable bit of land in sight.

Germany, instead of using her newly liberated energies at home in an endeavor to elevate the miserable condition of her working classes, taxes their bread and meat, never too freely supplied, to increase the size of her armies and the number of her battle ships. The defense and expansion of her colonial empire is her leading thought. A strange paradox: The workingman and the peasant are overburdened with taxes on the necessaries of life, so as to procure markets for a limited quantity of factory products outside of the field secured in open competition.

While professing friendship and brotherly love, they all have their eyes on their neighbor's throat, fearful only lest the other might clutch first.

As we are in danger of being drawn into this vortex, it is well to examine the range of possibilities and see what the trade amounts to, to obtain which the scientific intellect of Europe and America has been strained to its limits to discover new means of destruction for attack and defense unknown to the other brothers in the common bond of civilization.

It is a matter of course that trade among European nations does not come within this circle, nor of European nations with the United States. It does not depend on battle ships. In the annexed tables I have classified the countries in three classes: (1) Independent states; (2) colonies of European countries, populated by people of European stock; and (3) colonies and dependencies of European countries, but of non-European stock.

I have reduced the values of imports and exports of the different countries, published in their own currencies, to American dollars. As the values are paper currencies, silver currencies, or conventional values, and of fluctuating rates, I have in such instances taken a yearly average, which will be found in the footnotes of the tables.

I. Trade of Independent Countries other than of Europe and North America. [Pg 64]

Names of Countries.	Number of inhabitants.	Importations. Thousands of dollars.	Exportations. Thousands of dollars.	Imports per capita. Dollars.	Exports per capita. Dollars.
Asia (1895)					
China[19]	383,253	128,772	107,499	.34	.28
Japan[20]	42,270	90,681	62,443	2.14	1.47
All other states	27,000	30,000	82,000	1.10	1.18
America.					
Argentina[21]	4,000	103,058	108,671	26.50	27.17
Brazil[22]	16,000	96,000	97,000	6.00	6.06
Chile[23]	2,700	69,200	72,900	25.62	27.00
Peru[24]	2,600	7,560	9,000	2.90	3.30
Mexico[25]	12,600	42,000	22,000	3.32	1.76
Uruguay[26]	800	25,000	30,000	31.25	37.50
Venezuela[27]	2,300	17,000	22,000	7.40	9.56
All other states	11,300	34,000	46,800	3.00	4.14
South Africa					
Independent states	1,000	75,000	12,000	75.00	12.00
Total independent states	505,800	718,271	622,313		
Asiatic states	452,500	249,453	201,942		
American and South African	53,300	468,818	420,371		

The year is 1896, and where a different one is taken it is so marked against the country in the table. The figures only represent the direct merchandise trade. All specie and bullion shipments are eliminated from the account.

II. Trade of India and Dependencies and of Colonies and other Possessions of the United Kingdom (Year ending March, 1897).

Names of Colonies and other Possessions.	Number of inhabitants.	Importations. Thousands of dollars.	Exportations. Thousands of dollars.	Imports per capita. Dollars.	Exports per capita. Dollars.
India and its dependencies[28]	290,690	284,026	378,732	.97	1.30
Colonies.					
Cape Colony	1,820	91,800	39,000	50.04	20.15
Natal	778	18,000	6,500	23.15	8.20
Gold Coast and other Central African possessions	36,700	19,000	17,000	.52	.46
Canada	5,125	118,000	121,000	23.05	24.04
West Indies	3,614	30,000	25,000	8.33	6.94
Australasia and Oceanica	4,793	204,500	210,000	42.65	43.75
Trade of all countries under British flag	343,520	765,326	797,232		
Trade of colonies with white population	16,130	461,320	411,584		
Trade of Asiatic dependencies	290,690	284,026	378,732		

III. Trade of Foreign Possessions of all other Countries than the United Kingdom. [Pg 65]

Countries and their Colonial Possessions.	Number of inhabitants in thousands.	Importations in thousands of dollars.	Exportations in thousands of dollars.	Imports per capita. Dollars.	Exports per capita. Dollars.
A. France (1894).					
Asia	21,821	16,000	25,000	.73	1.14
Africa, outside of Algeria and Tunis	24,500	13,000	22,000	.53	.50
America and Oceanica	460	14,500	12,600	31.50	27.40
B. Germany (1897).					
Africa	10,200	2,189	1,078	.21	.10
New Guinea	400	72	50	.18	.12
C. Italy.					
Africa	400	5,600	3,000		
D. Netherlands (1895).					
East India	34,000	61,000	89,600	1.80	2.63
E.					
Philippines	7,600	11,000	20,000	1.50	2.63

Summary of Statistical Tables of the Trade of Colonies and Dependencies of European States and of Independent States other than of Europe and the United States.

Names of Divisions by Countries, Colonies, and Races.	Number of inhabitants in thousands.	Importations. Thousands of dollars.	Exportations. Thousands of dollars.	Inhabitants. Per cent to total.	Imports. Per cent to total.	Exports. Per cent to total.
Totals of tabulations I, II, and III	1,584,099	1,587,758	1,540,858	100.0	100.0	100.0
Under British flag	343,520	765,320	797,232	36.0	48.3	50.0
Under all other flags	605,180	818,779	790,527	64.0	51.7	49.8
Peoples of European descent	69,430	909,020	831,984	7.3	57.4	52.4
Peoples of other races	879,271	675,079	755,774	92.7	42.6	47.6
Anglo-Saxon	17,130	519,300	407,584	1.8	32.8	25.7
Latin-American	52,300	389,700	424,400	5.5	24.6	26.7
Asiatic races	806,611	618,079	706,274	85.0	39.0	44.0
African races	72,500	57,000	49,500	7.7	3.6	3.6
States and colonies, wool chief export	11,100	441,300	394,500	1.2	27.8	24.9

In examining these tables carefully the reader can form an idea as to how the world's trade is divided, and see what the world is arming to its teeth about.

The only Asiatic country about whose trade the possibilities of war may be entertained is China. Japan has shown her teeth and claws. The history of Poland, Port Arthur, or Kiao-tchow is not likely to find repetition on her territory. Only the defenseless tempt the avidity of the civilizing nations. The import trade of China, an empire with one fourth the population of the entire world,

is but half as much again as that of Japan, with but one ninth of the population of the Celestial Empire. Japan's trade has trebled within the last dozen years. Her imports of merchandise are over two dollars *per capita*. Those of China are thirty-four cents. It will be said that China [Pg 66] parceled out to modern nations will vastly extend in trading opportunities. So it may. We have, however, national disposition to take into consideration. England has devoted her best efforts to India. After a century spent in bringing the various races to submission, the process of "benevolent assimilation" is helped along by a never-ending flow of capital from England. She has become the teacher and administrator of the people of Hither and Farther India. It is doubtful whether under existing conditions any better government for their three hundred millions could be devised by any outer force. Though England does her utmost, as she understands it, to make the people under her dominion happy and prosperous, although the rule of law and a degree of local independence are established, yet she finds small thanks from her wards. They have their own notions of happiness, and seem to prefer misery of their selection to the advantages of the white man's ordering. The fact is, the brown man and the yellow man have different notions and desires from the white man. No amount of jostling, pushing, and urging will make them take up our views, our tastes, our working methods, except in the due development of time. Our ideas as to necessaries of life and theirs are widely different. Their simple needs are easily supplied from native hands, who understand far better than our potters do the clay they have to deal with. The progress in trade will not be rapid, and will certainly be disappointing to those who expect to see it extend into general lines of merchandise. The import trade of India and its dependencies (1897) is $284,000,000, inclusive of Ceylon and the net trade of the Straits Settlements. This amount, directly catering to the wants of fully three hundred millions of people, is but about one third more than the net import trade of Australasia, with a population of less than five millions of people. The *per-capita* consumption of imported merchandise of the Asiatic possessions of England is ninety-seven cents; of Australasia, $41.66. I must say here in explanation that the values of importations of merchandise, as published in the English returns and lately reproduced by the Bureau of Statistics of the Treasury Department, Colonial Systems of the World, is $305,000,000, which would make a showing of $63.33 *per capita*. But in the English returns the intercolonial trade figures are included. The Treasury Bureau did not mention this in its publication, and gave thereby a basis for erroneous deductions. I have deducted all the intercolonial trade figures of imports and exports from the returns of each of the Australian colonies, so as to bring the figures to a basis of parity with the accounts of Canada, and other colonies and dependencies where no duplications of this kind are possible. The figures of importations remaining over are reduced by this process to £40,500,000, or about $200,000,000 [Pg 67] —$41.66 *per capita*. The inhabitants of the Anglo-Saxon colonies of the world number but seventeen million. Their net imports of merchandise are $460,000,000. The seven hundred and thirty millions of Hindu and Mongolian populations import $530,000,000. These are the lands of fabled wealth. Antiquity and the middle ages dreamed of riches inexhaustible in connection with their names. To-day still the popular belief is that the wealth of nations is dependent on the conduct of direct trade with the far East. The country can not be rich whose millions find happiness in a sufficient supply of millet or rice, whatever the wealth of a small favored class may be. But these nations were the teachers of the barbarians whose descendants now populate America and Europe. The disciples have improved on the masters. We have improved the tools which they invented and applied new forces of production. We have cheapened the processes of production. We have quintupled, we have decupled time. But whatever our improvements in the tools, they are still our masters in the work. Any one who would endeavor to substitute the product of our mills in cotton, in silk, in wool, in wood, iron, clay, in lacquer, cloisonné, or enamel, for theirs, and not see at a glance the hopelessness, would indeed prove his incapacity for grasping the situation. Our best producers study with profit the work of China and, chiefly, of Japan, and are grateful for the inspiration they derive from it. But they do not attempt to copy. Neither in color effect nor design could they stand the test of comparison. Five thousand years have been recovered from the sepulcher under which they had been sleeping. But the oldest traces unearthed in the valley of the Euphrates still take us back to the farthest East as the originator of what we cover by the term "civilization." The Mongolian shares the lot of all who have benefited the race.

If we can not expect great openings for our mill products in Asia, Africa is a new field for the civilizing efforts of Europe, and will repay cultivating, perhaps. The negro has neither factories nor workshops. There at least is an unlimited field for trade expansion. Germany, the latest comer, with the zeal of all fresh missionaries, is eagerly taking up her colonizing mission. The result is not very encouraging. There is a fine set of buildings with garden spots and harbor improvements in the settlement at Cameroon, and a well-stocked graveyard of what were once good German boys, victims of the deadly climate and of the expansion fever. So far this is the only net showing to the credit side of the ledger. The territory in Africa covers nearly one million square miles. The possession of such an empire is worth a sacrifice, apparently, and Germany is not parsimonious in this direction. The contribution of the German Government to the [Pg 68] administration fund of the African colonies was $2,194,000 in 1896-'97. This does not include the expense of maintaining the military and naval forces stationed in the African settlements. The annual importations of all the colonies amounted (in 1897) to $2,261,000, inclusive of New Guinea. So it costs the Government more than one dollar to enable its citizens to do a dollar's worth of trade. The population is estimated at 10,200,000. What possibilities stretch out before us, if they could be made to wear shirts or uniforms like the native police force, which has been organized at Cameroon! The extent of the territory, however, precludes the possibility of successfully conducting the missionary effort to induce them to wear clothes. The question also remains open what return could be made, even if the recipients could be brought to appreciate

the advantage of a fuller covering of their nakedness than the traditional one.

France is in possession of territories in Africa, the population of which is on a more advanced status. The territories of the Senegal have been under French dominion for a period of two hundred years and more, and trade relations with the Senegal and Soudan have been assiduously cultivated. In Asia, Tonquin and Annam were to open the road to a very active trade with China. She has held undisputed lodgment since 1814 in Pondicherry and other towns in India that remained over to her from her East Indian empire conquered by Dupleix and abandoned by Louis XV's weak policy. Still, with all the tender care and an expenditure for the colonial service, as per budget of 1898, of about 80,000,000 francs, and not counting the colonial expense *êtat* of the ministry of war and of the navy, the entire export trade of France to her Asiatic possessions is 35,000,000 francs; to her African dominions, outside of Algiers, 22,000,000 francs; and to her American possessions, with barely five hundred thousand inhabitants, 35,000,000 francs. The territories to which this trade caters have a population of about twenty-two million in Asia and twenty-five million in Africa. If we include the French islands in America and French Guiana, the exports of French merchandise to all her colonies amount to about 95,000,000 francs. If we include the allowance for colonial service from the naval and military budget, France has an expense that exceeds the amount of her colonial export trade. How much better off France would be if she would drop this burden! She could do the same trading and save her money, annually wasted, and her men annually slaughtered to the mania of colonial expansion.

The forty-five millions peopling the French possessions in Asia and tropical Africa consume altogether about $30,000,000 worth of foreign imports. The French share of this is about $11,000,000, or a little over one third—eleven millions of trade against fourteen millions of direct [Pg 69] expense. The contributions to the American colonies are but $2,000,000, inclusive of about $1,000,000 to the penal establishment at Cayenne.

Italy's demonstration of the extent to which this madness can carry otherwise sane statesmen is fresh in everybody's memory. Outside of Russia, the poor—meaning the working classes—are in no country of Europe as poor as in Italy. If we take the production per acre in all the cereals as a gauge of interior development, then no European country west of Russia, not excepting Spain, is in a more backward state. Wise statesmanship would have found here a field for cultivation sufficiently large to tax all its energies. The peaceful acquisitions of industry did not satisfy the ambition of the Government. Conquests in equatorial Africa were deemed more essential to the kingdom's material welfare, but lately freed from the deadening grasp of clericalism and absolutism, than the improvement of opportunities lavishly present at home. What she has cultivated at an enormous expense of blood and treasure has borne the ordinary harvest of failure and disaster. The entire import trade of Massowah, to which the whole world contributed, and which is largely a transit trade, amounts to about $5,000,000. The expenditure on account of her Red Sea possessions for the year 1895-'96 is given in the Statesman's Year Book as 123,738,064 lires ($24,000,000). The contribution to the maintenance of this her "white man's burden," from 1882 to 1895, was 303,905,926 lires. At present (1897-'98), after the sobering lesson received in 1896, the net expense is about $3,500,000 (17,000,000 lires).

The three powers—France, Italy, and Germany—point a lesson of unmistakable significance. The figures speak for themselves. No amount of expense can make the African and the Asiatic consume an appreciable amount of European merchandise. No amount of cultivation can make the tropics endurable to the northern man. Labor and exertion on his part under the rays of a deadly sun and a miasma-breeding soil are entirely out of the question. Those who would make the endeavor in the manner of the temperate zone would only succeed the sooner in reaching the end of white man's settlement in the tropics, disease and death.

Many point to the Dutch East India settlements as a successful commercial enterprise. But, taking the best construction given to the story from the trader's point of view, the present satisfactory conditions have been reached after a great deal of disappointment, loss, and bloodshed. A large revenue is acquired from Government sales of colonial produce; still, with all this added to the other revenues from land tax, excise, and other duties, the Government has a [Pg 70] deficiency of over 10,000,000 florins a year in her East India possessions. The budget for 1898 shows an expense *état* of 146,150,164 florins, which is met by a revenue from all sources of but 135,204,203 florins.

This is the richest part of the Malay world, and for centuries has been in the possession of Europe's most enlightened people. The results, if the *per-capita* unit of imports and exports is taken as a criterion, are not different from those shown in the account of the Philippines, governed for centuries by Spain. The loss of their colonies is ascribed to the oppressive rule which the Spaniards exercised. The Netherlands, devoting all their efforts to the development of the resources of the islands, at least during the greater part of this century, do not show much better results. The imports *per capita* of the Dutch possessions are $1.80, and the exports $2.63. The imports of the Philippines are $1.50 and the exports $2.63 *per capita*.

From this we may be permitted to deduce that the Malay Islands are not likely to prove a more thankful field for cultivation by our traders than to the extent indicated in the trade reports set forth above.

Under the conditions here delineated, it would be inviting all the risks and dangers connected with expansion and colonization, while nothing is to be gained in a commercial sense that can not be realized by the means now in our hands.

All the ends of trade can be attained without territorial expansion. The trade in the hands of peoples under English sovereignty is open to all commerce on equal terms. Not even the sovereign country, except in the recent concessions by Canada, receives a preference. The protection of the British flag is tendered gratis to the colonies and dependencies. The imports of these countries cover about one half of the trade of all the world, outside of Europe and the United States. Though they have but 4.67 per cent of the population, the Anglo-Saxon colonies do sixty-nine per cent of the trade of all the colonies and dependencies of the British Empire.

South and Central America absorb about one fourth—24.6 per cent of imports and 26.7 per cent of exports—of the world's trade here summarized. The colonies peopled by Anglo-Saxon population and the Latin-American states together, though but 7.3 per cent of the inhabitants, do an importing trade of 57.4 per cent of the trade of the world here reviewed. The countries trading under the protection of the British flag and the Latin-American states combined have about seventy-three per cent of that trade among them. All this trade, as well as by far the greatest part of the rest, is incontestably accessible to-day on an equal basis to all the world. The [Pg 71] key to it lies in the best terms, the best value. The trader and not the admiral governs the field. Prince Heinrich will not succeed better than Admiral von Diederichs in convincing China of the advantages Germany can offer if Mr. Carnegie's rails are cheaper than Mr. Krupp's. A whole fleet of American battle ships will not convince the Asiatics that our cotton goods are as desirable as the English so long as the latter make goods suitable to their markets, and the Americans offer only products calculated to cover the home demands.

The golden rule is a more effective trade opener than the cannon's mouth. Fair and square dealing among nations does not entail expense, but brings in good returns. Our national policy, however, has been one studiously calculated to array the world against us. Like every policy in behalf of a selfish interest, it injures the foreign people against which it is directed far less than the nation which devises it.

The trade of Australasia, Argentina, and Uruguay, and the Cape is based chiefly on wool and hides. The imports of these countries, numbering but eleven million inhabitants, amount to $440,000,000, equaling in amount the trade of China, Japan, Persia, and India, with their seven hundred and fifty million inhabitants. Though but 1.2 per cent of the population of the world (outside of Europe and the United States), their imports are 27.8 per cent of the totals of the figures in the tables. In exports they do about $400,000,000, or 24.9 per cent of the total sum of exports here given. It would be worth cultivating friendly relations with them. They are inhabited by people of European stock, and come nearer to the standard of life of Americans than any of the other nations of the globe. Our latest effort to draw them closer to us was the Dingley tariff, with its duty of eleven cents a pound on greasy wool and of fifteen per cent on raw hides. The action can not be construed as a very friendly one. But neither is the effect as calculated by the wise heads who insisted on the provisions of the wool tariff, the woolen and worsted manufacturers of the East, and the wool raisers of the West. The wool and woolen trade of America has suffered many vicissitudes during the thirty-five years of high tariffs. It has gone through many periods of depression. But it is doubtful whether at any time more disastrous conditions existed than have marked the twelve months ending at this writing (March, 1899).

The situation can be appreciated from the fact that wool, imported prior to the passing of the Dingley tariff, is being reshipped to England, where it is bringing better prices than can be obtained here under the ægis of the protective duty of eleven cents a pound. Three and a half [Pg 72] million pounds were shipped in the seven months ending January 31st.

We should profit by this experience, try to cultivate friendly relations in parts of the world where advantageous trade connections can be established, instead of following the *ignis fatuus* of Asiatic expansion.

THE INTERPRETATION OF NATURE.

By EDMUND NOBLE.

It is an interesting and suggestive fact in Nature study that at the outset man was thrown utterly upon himself for the very vocabulary of the world-puzzle which presented itself to him for solution. He had not only to unriddle his "inscription in an unknown tongue," but to evolve even the possibility of an explanation out of his inner consciousness. His first theories of the universe were based, not on anything which the cosmos was, independently of him, but upon his own nature and activities as a living animal. This resort to himself as his chief means of interpretation resulted from the very nature of the knowing process; for knowledge of things is never in any absolute sense what things are, but is rather what they are like. When we cognize an object we do it by referring that object to the class of objects which in one or more respects it resembles. And as in this process we draw from the objects most familiar to us the principle of explanation which we need for the less familiar things that have not yet become part of our mental possessions, much depends upon priority in the setting up of mental classes, as well as on the strength of the impression which they make upon the mind. The earliest and deepest class impressions are necessarily those which arise out of man's knowledge of himself—of his body and the parts thereof, of his corporeal activities, and of his feelings and thoughts; next, of the bodies of other men and of their movements; finally, in the order of vividness, of the animate and

inanimate objects most nearly related to his life. It is these classes which, by virtue of their priority and strength, naturally acquire dominating influence over all later acquirements, and it is to them that the mind refers the impressions gained from the more remote inorganic world.

Among the simpler illustrations of the effort man makes to assimilate the external system to himself are those with which we are more or less familiar in the domain of language. We find them first in the forms for gender by which, in all inflectional tongues, inanimate objects are to this extent likened to living animals. A similar tendency is at work in the widespread lingual habit [Pg 73] of naming things after parts of the body, as in the case of "door," called the "eye of the house" by the native of Banks' Island; of "son-tree," the term applied by the Siamese to "fruit"; of the Malay's use of the noun "child" for "lock"; of "house-belly," the African Mandingo's equivalent for "in the house"; and of "hair," often used for "leaf" or "feather" in many Melanesian languages.[29] In more modern forms of speech the process is suggested by such expressions as the *head* of a bridge, the *eye* of a needle, the *mouth* of a river, the *neck* of an estuary, the *trunk* and *arms* of a tree, the *lungs* of a bellows, the *bones* of an umbrella, the *nose* of a promontory, the *ears* of a book, the *fingers* of a clock, the *legs* of a table, the *veins* of marble, the *foot* of a mountain. Then there are analogies based on the activities of the human body, for when we describe things as standing, sitting, or lying; as rising, falling, running, or climbing—when we use expressions like "striking clock," "dancing light," "sleeping lake," "yawning precipice," "laughing skies," "babbling brooks," "raging billows," we are applying to the objects named terms originally used to describe our own acts. The sense of hearing, again, is utilized in such expressions as *taube Nuss* ("with nothing in the shell") and *taube Kohlen* ("those which have burned out"). So the defect of blindness is objectified in the *cæcum vallum* of Roman speech, in *ciego*, said in Spanish of cheese that "has no eyes," and in the *blinder Schuss* of the Germans, whose more familiar *Augenblick* everybody recalls. Not less suggestive are the numerous expressions which project conceptions of life and death into the environment, such as the *caput mortuum* (*tête morte*) of chemistry, *eau vive* (*Quellwasser*), "dead water" (turn of the tide), *todte Farbe* and *lebhafte Farbe*, *vivus lapis* (firestone), "quicksand" and "quicksilver," the "dead of night," "dead weight," a "dead level," and *todtes Kapital*. Nor must we forget that the reading of vitality into inorganic objects, common enough among savages, has by no means disappeared from civilized races. Dr. Stanley Hall's inquiries have shown that out of forty-eight children just attaining school age, twenty believed the moon and stars to be alive, fifteen thought a doll and sixteen thought flowers would suffer pain if burned. One pupil described the crescent moon as "half stuck" or "half buttoned" into the sky; the spluttering of coals in a fire was called "barking" by a girl four years and a half old. Miss Ingelow says that when over two years old, and for about a year after, she had the habit of attributing intelligence not only to all living creatures, but even to stones and manufactured articles.

This projection of words originally descriptive of the human body or of its activities into the [Pg 74] objective world of Nature finds its richest illustrations in poetry,[30] where it may be held to represent less the elaborate artifice of a cultured mind than one of the most primitive tendencies of that mind powerfully swayed by emotion. Yet the process belongs equally to the more prosaic efforts which man puts forth to utilize the objects of his environment in the interests of self-maintenance. One of the earliest of these is seen in the use of words describing parts of the body to facilitate the description of the external world in its numerical aspects. Thus the Chinese use for "two" certain syllables (*ny* and *ceul*) which originally mean "ears," the Hottentots employing the word for "hand" in the same sense. In middle high German the word for "sheaf" (*Schock*) signifies sixty, and is applied in that sense to all kinds of objects. The Letts, owing to their habit of throwing fish three at a time, employ the word *mettens*, "a throw," in the sense of "three." Among the same people flounders are tied in lots of thirty, whence has arisen the practice of designating thirty by the word *kahlis*, meaning "cord." The Quichuas attach the significance of ten to the word *chuncu*, "heap." The Gallas word for "half" has been traced to the verb *chaba*, "to break," and is the equivalent of our own word "fraction." So in a large number of languages the term for hand signifies "five," "two hands" meaning ten, and "man" ("two hands and two feet") twenty.

A like origin must be claimed for the measures of space and weight needed by man in his industrial and commercial activities. The finger, the thumb, the hand, the palm, the forearm, the foot—the extended arms, as in the ancient *orgya*, and the extended legs, as in the modern yard—have all played a fundamental part in determining the standard measures of the civilized world. To the same class belong the γυη, the extent of field that could be worked by a laborer in one day; the *stade*, the distance which a good runner could traverse without stopping to take rest; also measures of time, such as the old division of the day based on the length of a man's shadow.

The human body was thus of primary importance as a means of comprehending and coming into relations with the external world. But men also sought to make the environment intelligible to them by projecting into it the images gained from the more general aspects of their life. Such phrases as "pig of iron," "monkey wrench," "battering ram," "lifting crane," remind us of a period in which objects were actually shaped so as to enable the mind to accommodate itself more completely to the thought of their vitality. The Greek sailing vessel, for example, was so constructed—with the body of a bird, with cheeks, eyes, and projecting ears—as to make it seem to the navigators of the time as almost alive. And the dolphins, eagles, ravens, and dragons which [Pg 75] threatened England from the prows of the invading Danish fleet have had their prototypes in almost every nation that has betaken itself to the sea.

Not less suggestive are the more general aspects of the process. Our ancestor called the earth's

satellite the "moon," or "measurer," because it served him as a divider of time. The familiar grains of wheat and barley which he harvested became the units of his measures. So the names of his seasons were based on the fall of the leaves, the reappearance of particular stars, or the periodical inundations upon which he depended for his food. The most primitive method in chronology is that which enables man to orient himself in the world of time by associating particular lunations with vicissitudes of weather, with seasonal aspects of vegetation, and with the constantly changing sights and sounds of the animal world. In the calendar of the Crees,[31] for example, we find such designations as "duck-month," "frog-moon," "leaf-moon," "berries-ripe-month," "buffalo-rutting moon," "leaves-entirely-changed," "leaves-in-the-trees," "fish-catching-moon," "moon-that-strikes-the-earth cold," "coldest-moon," "ice-thawing-moon," "eagles-seen-moon." So in the calendars of Central America and Mexico,[32] the months are named variously after the arrival of birds, the blossoming of flowers, the blowing of winds, the return of mosquitoes, and the appearance of fishes. The Greeks constantly used the movements of birds to mark the seasons; the arrival of the swallow and kite were thus noted. Hesiod tells us how the cry of the crane signaled the departure of winter, while the setting of the Pleiades gave notice to the plowman when to begin his work. The Incas[33] called Venus "the hairy," on account of the brightness of her rays, just as the Peruvians named her the "eight-hour torch," or "the twilight lamp," from the time of her shining. One at least of the three portions into which the Greeks divided their night received its name—περὶ λυχνων ἀφάς—from the social custom of lighting the lamps at dusk. For whole races the departure of the sun made night a time of danger, and man did his best to lessen the mystery of the heavens by filling their obscure depths with the figures of animals and heroes, or by likening their shining lines of cosmic cloud to a road or highway for the march of beings celestial and terrestrial. Thus, for the speakers of Sanskrit the Milky Way was "The Path of the Gods"; the Lithuanians dubbed it "The Bird Road"; in Low German it is known as "The Way of Cows"; the Cymris associated it with the course of the wind; for [Pg 76] Scandinavians it was "The Road of Winter"; the Persians viewed it as the route along which the straw carrier drew his burden; to this day the Winnebagoes call it "The Way of the Chiefs."[34]

Science itself is indebted to terms and phrases in which outer realities are assimilated to the circumstances of the life lived by man and by the societies which he forms. Such words as "attraction," "repulsion," "resistance," "nature," "body," "atom," "current," contain obviously anthropomorphic elements. The human origin of the idea conveyed by the term "inertia" may be more or less veiled by unfamiliar Latin elements, yet it is recovered for us again in *Trägheit*, "idleness," the German form of the word. The phrase "natural selection" contains a teleological element which has more than once been used to throw discredit on the process which it describes. And when one observes how persistently such an anthropopathic expression as "affinity" is still applied to chemical reaction, or with what *naïveté* the term "law" is transferred from the realm of human jurisprudence into the domain of natural processes, one ceases to wonder at the constant confusions of outer with inner in which so much of the psychomorphism of the time has had its origin.

It would be strange, then, if, seen in so many of man's efforts to interpret the inanimate things around him, this process of self-projection should not also be valid for the larger relations of his mental activity to the universe. It is but a step, in fact, from the application of anthropomorphic words to the objects and processes of Nature, to the employment regarding such processes of anthropomorphic thought. As the child finds the satisfaction of its fancy in the discovery of some strange face as suggested to him in the decorations of the wall paper which surrounds his sick-bed, or in tracing out from the contours of clothes hung up within range of his vision the preposterous outline or figure of some human likeness or caricature, so the savage, with a deeper purpose born of necessity, traces out from the larger patterns of the moving world about him the organic shapes, embodying will and personality, that are to serve him as explanations of the external power which touches his existence for good or for evil, and which, thus serving him, enable him to come into relations with that power. It is the deepest interests of human life which make this process necessary, and it is of the very nature of the process that the characters thus projected into the environment must always—throughout the history of human ascent, and at every particular stage of it—be closely and definitely correlated with the degree and kind of the self-knowledge which is its source.

The earliest of the animal characters displaying this correlation, and used as a means of [Pg 77] understanding the environment, could not well have been other than that of motion. That by the higher mammals, at any rate, moving things, even when inorganic, are generally regarded as alive, is a view rendered probable by a large body of evidence.[35] But when man finally appeared on the scene, a new element came in to complicate the merely animal attitude in which vitality was attributed to inanimate objects in motion. By contemplating the phenomena of his subjective life, and observing analogous phenomena in his fellow-beings—through the consideration of dreams, swoons, even death itself—our ancestor discovered in himself a character deeper than that of vitality; came to recognize that the living creature, animal and human, possesses an inner principle or essence underlying its activities; is not only "alive," but also "animated." At first the conception of vitality was one with the conception of bodily activity; at last man learned to differentiate the movements of the body from an inner essence to which he believed them to be due—learned, in a word, to distinguish between the corporeal existence and the soul. And having effected this first rude division of the characters of soul from the merely physical attributes of life, our ancestor soon projected the new view which he had reached of himself into the objects of his environment. The beneficent influences of Nature, so necessary to his life, he now invested with the good purposes of the better nature within him; in the maleficent forces of the cosmos he

read the malignant will of his own angry passions.

But it is not as mere phenomena that these powers, thus finally ensouled and regarded as personal, can be thought about. In the beginning the human mind carries on its mental processes largely with the aid of images—recovered images of something seen, heard, felt, or tasted—and is yet far off from the stage of scientific thought in which abstract concepts take the place of the recovered mental pictures which have been yielded through the senses. Man thus needed concrete images with which to think about the personal powers of the external world, and he naturally found them in the animal and human shapes already familiar to him. Discovering some likeness between a Nature force and some animal, he henceforth associated the two, and recalled the image of the animal as the more concrete means of mental recovery when he wished to think of the abstract Nature power. Or, associating some departed ancestor, relative, hero, or king with the Nature force—an association which would be greatly strengthened by belief in the survival of the soul after death—he gradually confounded the disembodied human power with the [Pg 78] soul of the Nature power, and through the law of least effort, used the concrete image of the departed human being to stand in his mental processes for the much more difficult thought of the Nature force. But, whatever the process, animal shapes were obviously needed to reduce the Nature powers to such a degree of concreteness as would make it possible for primitive man to deal with them as objects of thought. And it is not less certain that while, for some races, the earliest shapes thus utilized were those of the lower animals, the final form for all races was that of man himself.

In the anthropomorphic stage, then, there is the same effort to understand the external system by assimilating it to something with which man is already familiar. The worshiped deities may be many or few, numberless as the Nature forces, polytheistic as among the Greeks and Romans, or one as in the monotheism of the Semite. Man likens them to himself, attributes to them not only his outward shape, but also his failings and virtues, making his Pantheon resemble not only the social order, but also the political system under which he happens to live. It is the completeness of this assimilation which made anthropomorphism the most persistent aspect of man's intellectual growth the world has known. Yet the view could linger only as the possession of the intellectually slothful and immature. The inadequacy, the crudeness, of the conception in which Deity was imaged as a gigantic man gradually forced itself upon the attention of the more thoughtful. Increased mental activity, a better acquaintance with natural processes, brought the idea of a power above Nature rather than merely superior to man; and as the human mind passed from the conception of the superhuman to that of the supernatural—as, moreover, the thought of merely local gods gave way to the idea of gods not limited in their functions to particular areas—the anthropomorphic shapes naturally fell away from the powers they could no longer adequately represent.

Then other changes, strictly correlated with man's advancing knowledge of himself, ushered in the latest stage of his attitude toward the external system. For in the same mind which had been compelled to reject crude anthropomorphism, there had been growing the consciousness of man as something more than a mere compound of vitality, consciousness, and will—something more than a set of bodily and mental capacities essential to the work of self-maintenance—the thought that man was the sum of his higher, not of his lower qualities, that henceforth he must be measured by the activities which he carried on in the domain of pure thought. And this recognition of mental attributes as the most worthy, the most exalted characters of human personality, could not fail to impress itself upon the conception of deity already undergoing [Pg 79] deanthropomorphization. More and more, therefore, in the higher mind of the race, the Divine Being, not only losing his former bodily form, but yielding even the grosser attributes of personality with which he has been invested, becomes for the thought of man a psychical being in the deepest sense of that term. Anthropomorphism, or man-likening, passes away, and in its place comes psychomorphism, or mind-likening.

Two aspects are thus recognizable in the mental interpretation of the environment: on the one hand an aspect which may be called causal, since it seeks the source of the power exerted by Nature forces and objects; on the other, an aspect which is obviously formal, its main significance being that it condenses, so to speak, groups of qualities into a single mental sign. The causal aspect yields, in howsoever simple or complex a form, a theory of the cosmos or of its parts; the formal aspect is no more than a means, ready at hand, in the visible bodies of animals and men for facilitating the use of that theory in processes of thought. Hence we may regard vitalism, animism, psychomorphism as so many stages of man's attitude toward the external system, corresponding with the degree of his power to apprehend the more abstract as distinguished from the more particular and superficial characters of things that come within the range of his knowledge. In the first, he explicitly recognizes vitality, the most obvious character of Nature force; in the second, subsuming vitalism, he raises the soul life to the place of honor; in the third, subsuming both vitalism and animism, he emphasizes in psychomorphism the highest human qualities which his mind enables him to recognize.

The passage from the idea of multiplicity to that of unity is itself an inseparable part of the total process. As at the beginning man reads vitality into the separate objects and forces of Nature, without any thought of their underlying unity, so he regards as discrete, unconnected, objectively unrelated, the multifarious souls with which, in his thought, these various powers of the environment have come to be animated. But in course of time, by an inner necessity of intellectual growth, relations come to be perceived between the forces of Nature, likenesses are recognized between the functions of spirits and deities—between the powers put forth and the

results achieved. The result is a process of coalescence which, to describe it in the briefest way, first merges a large number of spirit-evolved gods into a smaller number of relatively independent divinities, forms these into pantheons of gods each subordinated to a superior, and finally unites all beings regarded as divine in the single, all-comprehending, omniscient and omnipotent Deity of monotheism.

In all this advance, moreover, we find that the process illustrated by the changing phases of [Pg 80] man's mental attitude toward Nature also holds good of the multifarious acts by which, in what is known as religion, man has sought to realize that attitude in conduct. For, in seeking to adjust himself to the system of Power, man has been forced to conceive of his Pantheon in terms as well of his social arrangements as of the political system under which he happened to be living. The spirit world of a horde of savages could only reflect the indefiniteness and disunion of the nomads whose imagination it satisfied. But as the household made its appearance, as a definite social structure arose, and the straggling tribes began to be united into nations, the gods themselves took on the characters of an analogous transformation. The divine selfishness—the "*remota ab nostris rebus*"—long ago satirized by the poet Lucretius, obviously correlated with the attitude of man toward man, just as naturally gave way, with the growth of the social sympathies, to the thought of that more active concern in human affairs which is one of the salient characters of the later phases of monotheism. The original indifference of Deity toward ethical issues—a widespread feature of the earlier religious conceptions—could not but pass away with the moral stagnation of the ancient communities out of which it had arisen. So the comparatively new thought of a God definitely identified in his aims and activities with the cause of moral reform is no less obviously a result of the new attitude of man himself toward problems of social improvement; while the persistence with which, in human thought, morals remain associated with religion sufficiently illustrates the extent to which man's view of each has been determined by the self-knowledge which underlies his attitude toward both. Note also, finally, the manifest relation in which our human thought regarding mind and body has always stood toward conceptions of a world-soul, and then the dependence of man's view of the relation of God to the world upon the knowledge of his own planet and of its place in the universe. For as long as our ancestor held the old geocentric theory of the cosmos—regarded the heavens as a set of spheres revolving around a flat earth—the thought of a deity outside the world related to it as a mechanician might be to a cunningly devised piece of clockwork which he had brought into existence, was inevitable. But when the geographical discoveries of the fifteenth century co-operated with the revelations of Galilei to secure the final triumph of the Copernican over the Ptolemaic theory of the world-order, the ancient view of Deity as external to his creation gave place to the essentially modern conception of his immanence.

If now we attentively examine the progress above described, we shall find that the earliest attitude of the human mind toward the external system tends in the latest to repeat itself on a higher plane and with a richer content. Thus vitalism, by the process of unification and [Pg 81] intensification, culminates in anthropomorphic monotheism, while animism, through the coalescence of objects and forces at first believed to be separately animated, finally develops into pantheism. These two lines of thought, moreover, tend themselves to converge, or, at any rate, to become interchangeable, since monotheism, by deanthropomorphizing itself, approximates to pantheism, as is well seen in the Christian theologies and ethical religions of the world; while pantheism, by emphasizing the characters of intelligence and will, is sometimes hardly to be distinguished from those modern forms of monotheism which teach the doctrine of immanence. The intellectual outcome of the whole movement, embodying the modern attitude in Nature philosophy, is thus no longer anthropomorphism, but psychomorphism, since it reads into the universe, not the characters which distinguish human beings from the lower animals, but the highest manifestation of the characters recognized to be common to both, namely, psychic characters—the characters, in a word, of mind. For the deepest reaches of human thought, the process of man-likening has thus given way to the process of mind-likening. On the subjective side of mental inquiry we get psychomorphic monotheism, or what may be called theological pantheism; while on the objective side we reach scientific pantheism, or monism. It is true that the psychomorphism of scientific monism is reached by a process different from that which has culminated in the mind-likening of theological pantheism. Yet in both cases there is the same projection of intelligence into the external system as a means of comprehending it. And as the intelligence of atoms implies their vitality, we really return in scientific monism to the vitalistic attitude of the primitive observer of Nature. The salient difference between the two views is this: that while early man subsumed under his concept of vitality only the rudest characters thereof, the terms in the mind of the monist connotes in all their richness the ideas associated with mind.

Enough has now been said to show the basis on which rests the whole superstructure, of man's mental attitude toward the cosmos. Despite all uncertainties regarding the details of the process, we may be assured of its fundamental nature, and are thus compelled to recognize the dependence of the forms of man's mental attitude toward the universe upon his knowledge of himself. It is because his own actions have their source in a personal will that he refers external movements to will. He is conscious of his own acts, and the world around him can not be devoid of a like illumination. Does he himself plan? Nature must also be intelligent. And the highest qualities which he can discover in himself he reads unhesitatingly into the cosmos.

At first sight, then, knowledge may seem inextricably involved in the process here described. If [Pg 82] man can not know the external system to which he must adapt himself save by assimilating it to himself—save by interpreting it on the basis of analogies which he discovers between his own body and its activities, and the world with its activities—are we not committed by our very nature

as organisms to all the errors which that nature imposes upon us? If, in other words, every effort to view the universe as it is, independently of us, be rendered impossible by the very nature of the knowing process, with what chance of success shall we seek to eliminate those vitalistic and psychomorphic characters which seem to belong to that process as its very warp and woof? In reality our knowledge inflicts upon us no such dilemma. Man is the helpless "measure of the universe" only to the extent that his reasoning processes are undeveloped. That knowledge must always have a subjective element is undoubted, but that man must always mistake the subjective vesture with which things are clothed by the senses for the things themselves is an inference which the whole history of thought negatives. While his life remained simple, primitive man could regard appearances as realities without prejudicing the overplus of utility brought to him by his knowledge. Yet as his relation to the natural surroundings grew in complexity, the importance of the reasoning process, with its veto power over the deliverances of the senses, began to assert itself. At first accepted with little or no demur, these deliverances came more and more to be challenged in the interest of self-maintenance; and finally, by expansion of a germ possessed by the mind in the beginning, there was developed that way of dealing with the testimony of appearances which we call the objective method. The evidence previously accepted had been, though on the whole useful, in large measure misleading. For in appearances men saw and felt mainly what Nature was for them, and only to a minor degree what the external world was for and in itself. The great need of the investigator of Nature is to know what things are independently of man, in order to know how they act on one another, as a means of knowing how they will act on the human organism, and how that organism may react on them in the interest of its own life. The prejudice done by implicit reliance on sense testimony arose out of the fact that it presented objects as largely unrelated to each other—as so much being, rather than as so much doing, acting and interacting, determining and interdetermining. It became the function of reason to develop, out of the material furnished by the senses, a knowledge of the true nature of the system external to man and involving him in its scope which we call universe. In the carrying out of this function the analogical process has remained, but the analogies utilized, from being likenesses between what things seem to be to the senses, have more and more become analogies between propositions made regarding what things do, regarding how things act upon, are related to and determine each other. [Pg 83]

Our knowledge of Nature, therefore, illustrates progress from a stage in which external objects are viewed as so much doing—from a stage in which they seem more or less isolated, more or less independent of each other—to a stage in which we know them as acting and interacting, and therefore, by virtue of this action and interaction, as interrelated and interdependent. It was because man had to begin with the thought of the world around him as a series of unconnected aspects that he fell into the error of regarding every object as containing within itself the powers which it put forth; it was by gradually progressing to the knowledge of the external system as a process that he discovered how inextricably the smallest "flower in the crannied wall" is linked to its vastest environment, and how dependent must be the mechanism of the molecule, as well as of the solar system, upon the whole universe Power which we call cosmos.

Thus also is it with man's method of interpreting the external world system. At first unable to fully perceive his own relation to that system, as part of his inability to perceive general cosmic relations, and therefore viewing himself as more or less independent of Nature—as something imposed upon it rather than as something arising out of it—he naturally sought to force it for purposes of explanation into the narrow limits of his knowledge of himself, of his feelings, his thoughts, his institutions. But as he grew in the power to comprehend his place in the system of things—to understand the way in which the objects and forces of the world were related to each other, together with the way in which he, as knowing organism, was related to the universe—he gradually ceased from his vain striving to subject the cosmos to himself, and at last learned not only to subordinate himself to the cosmos, but to trace to it unreservedly the whole method and meaning of his origin as a living, thinking organism. Man in the beginning could be no more than the measure of the universe. That he has come at last, wielding the objective method, to be its measurer, is the culmination of a struggle between false and true ways of interpreting Nature which has had the whole history of human thought for its arena, and for its final triumph the establishment of the objective or scientific method of investigation upon impregnable foundations.

FROM SERFDOM TO FREEDOM.

[Pg 84]

By EDWARD BICKNELL.

However keen our interest in the problems arising out of the recent Spanish war, and however earnest our study of the policy to be pursued toward our new dependencies, we should not forget that the problems pressing for a solution before the war are still with us. The labor question, which then commanded so much of our thought, is still unsettled, and is by no means dwarfed by the subjects now upon every lip. Rather, as has been shown in an article in a recent number of this magazine, this question really forms one of the most important elements of the present situation, and should not be lost sight of in shaping public policy. We are entering upon an untilled field as far as our institutions are concerned, and we have the opportunity to start on a higher level in treating the relations of capital and labor in our new possessions, if we have the wisdom to know how, and the courage to do as well as we know.

It will help us in a consideration of the present status of the laborer and of his future if we study his past, beginning, if not with Adam, at least with the laborer's entrance into English history as a distinct class. Any one at all familiar with Green's Short History of the English People will see how much use I have made of that instructive and fascinating work. And if I tell only an old story, it may still be of value to many of us in recalling facts almost forgotten, and a help to others whose vision into the past is limited. Brushing away the cobwebs in the old attic of our father's house usually brings to light treasures the recollection of which had slipped from our minds.

The free laborer, the man who works for wages, for whom and where he chooses, did not exist as a class until within about six hundred years. In the early days the laborer was tied to the soil where he was born. Such a thing as a laborer going about to seek work where he would, or having much to say about his master or his wages, was usually out of the question.

At a very early day the towns or boroughs of England had preserved old rights, or regained them, which the rural part of England had lost, and in general serfage could not exist there as it did in the country round them. Trade and manufacture, such as they were in that day, did not make the demand for labor which was made by the agricultural pursuits of the country or in the castles of the nobility. So we do not find in the towns of the eleventh or twelfth century the large labor class we do to-day. In general we may fairly say that the labor class began in the country.

The manorial system had divided the rural part of England for cultivation and general order into [Pg 85] large estates. The lord of the manor occupied a part of the estate for his own demesne and divided the rest among his villeins or serfs, who in return were obliged to render services to him. It is not necessary for my purpose to enter into any long description or discussion of the different relations existing between different tenants and their overlord, or the differences existing under Saxon or Norman rule. The general relation of lord of the manor and his tenants or villeins or serfs is the main point to be observed. The villeins or serfs of the manor cultivated the lord's home farm or demesne, filled his barn, cut his wood, and did all his work. "These services were the labor rent by which they held their lands." Some of these tenants, the villeins, were obliged to work on the lord's demesne at harvest only and to help plow and sow, while the others, the serfs, to speak in general terms, were obliged to help on the home farm or in the castle the year round.

In course of time the use of a certain parcel of land by the tenant and a right to pasturage and so forth on the one hand, and the amount and kind of service required on the other, became definitely regulated by custom; and instead of the use of the land being a mere indulgence given to the tenant to be taken away from him on any whim of his lord, it became a definite right in the land which must be respected and could be pleaded at law.

"The number of teams," and so forth, "the services that a lord could claim, at first mere matter of oral tradition, came to be entered on the court roll of the manor, a copy of which became the title deed of the villein." So after a while instead of "villein" he became a "copyholder."

As time went on it grew to be customary, instead of rendering services for the use of the land held by copyhold, to pay a money rent. In other words, the system of leasing the little farms came into use, and from that came the tenant farmer. This left the other laborers about the lord's demesne or his castle as before. While the class of villeins, who did only occasional services, although definite as to amount and time, gradually commuted these services into money payments, and became farmers, the other serfs still remained on the manor, liable to do their work when and where it was customary. This rise of the wealthier tenants made a new class between the large proprietors, the lords of the manor, and the tenants or serfs still bound by custom to work for their lords. But the same process which freed the farmer from personal service in time became the chief way of freeing the serf also. Until this came about the serf or laborer, whatever other rights he might have, and he was not a slave, was born to his holding and his lord. He could choose neither master nor place of work. "He paid head money for license to remove from the estate in search of trade or hire, and a refusal to return on recall by his owner [Pg 86] would have ended in his pursuit as a fugitive outlaw." But the advance of society silently worked to free the laborer from this local bondage. The runaway serf gained freedom by residence in a chartered town for a year and a day. The influence of the church was directed toward his emancipation, at least on all estates outside of its own, but the main cause was the growing tendency to commute labor services for money payments. As Mr. Green says: "The luxury of the castle hall, the splendor and pomp of chivalry, the cost of campaigns, drained the purses of knight and baron, and the sale of freedom to a serf or exemption from services to a villein afforded an easy and tempting mode of refilling them. In this process even kings took part. Edward III sent commissioners to royal estates for the especial purpose of selling manumissions to the king's serfs, and we still possess the names of those who were enfranchised with their families by a payment of hard cash in aid of the exhausted exchequer." The Crusades, whatever else they may have accomplished, aided in this freedom for the serf. Those costly expeditions dissipated the estates of the barons, and, to use Hume's somewhat strained expression, "Their poverty extorted from their pride those charters of freedom which unlocked the fetters of the slave." And so, following the rise of the farmer, came this new class—the free laborer. By the latter part of the fourteenth century labor was no longer, as a rule, "bound to one spot or one master; it was free to hire itself to what employer and to choose what field of employment it would."

This is the beginning of the labor class as we know it. In those times labor was abundant and therefore cheap. The landowners in the country and the craftsmen in the town found plenty of help, and the new class then coming upon the stage could go where it was needed. From a serf

the common laborer had become his own master as far as choosing his own employer and the place of his employment. But just at this time a condition of affairs arose which put an end to this state of things. In 1348 came the Great Plague. That swept away more than half of the three or four millions who then made up the population of England. The plague and the sudden rise of wages which followed, although coupled with an increase in the cost of living, quite naturally brought on an outburst of lawless self-indulgence which told especially upon the laborer looking for work. He easily became the "sturdy beggar" or "bandit of the woods." While harvests rotted to the ground from lack of hands, in the towns labor was just as scarce and equally as independent. The landowners and wealthier craftsmen were startled and terrified by "what seemed in their age the extravagant demands of the new labor classes." Here we have the labor problem at once and [Pg 87] at the beginning. And from that time to this that problem has been with us. With the capitalist one person and the laborer another there has been always more or less discord. As Richard T. Ely has somewhere said, although in theory capital and labor should be allies and not enemies, the interests of those furnishing capital or labor are not precisely identical. But five hundred years ago the labor class of to-day had just come into existence. It had no organization then, and its members few political rights. The landowners and craftsmen could appeal effectively to the crown and Parliament through their wealth, their political power, and the craftsmen, especially, through their organizations. The laborer had only himself and brute force. As a result, the legislation of that day reflects the demands of the upper and middle classes only. The laboring class was considered only as it affected the landowners and craftsmen. So the labor troubles of that day were met with the Statute of Laborers. "Every man or woman," runs this famous provision, "of whatsoever condition, free or bond, able in body, and within the age of threescore years, ... and not having of his own about the tillage of which he may occupy himself, and not serving any other, shall be bound to serve the employer who shall require him to do so, and shall take only the wages which were accustomed to be taken in the neighborhood where he is bound to serve" two years before the plague began. A refusal to obey was punished by imprisonment. Here was an attempt to fix the rate of wages by statute, and to fix them very much lower than a fair market rate; and, further, to force the unemployed laborer to serve any man who first demanded it. The statute failed in its object, naturally, and so sterner measures were adopted. "Not only was the price of labor fixed by Parliament in the next statute of 1351, but the labor class was once more tied to the soil." It was made the servant not of one master but of a class—the employers. "The laborer was forbidden to quit the parish where he lived in search of better-paid employment; if he disobeyed, he became a 'fugitive,' and subject to imprisonment at the hands of the justices of the peace." Provisions had risen so that a day's work at the legal wages would not purchase enough for a man's support, and therefore no such law could be enforced literally. Still, the landowners persisted in trying, and at last the runaway laborer, the man looking for better wages, was branded on the forehead with a hot iron, while the harboring of serfs in towns was rigorously put down. As the landowners wanted all the labor they could get, the commutation of labor service for money payments ceased, and every effort was made and every quibble taken advantage of to annul manumissions previously made. In the towns, under the pressure of the craftsmen, the system of forced labor was applied with even more rigor than [Pg 88] in the country, and strikes and combinations became frequent.

That is the state of things in free England at a time when labor was not strong enough to protect itself—called upon by the law of the land to work for less than living wages or be branded as cattle! The irrepressible conflict between capital and labor began with the very beginning of the existence of the labor class.

In such a condition of things as here indicated, is it any wonder that there were labor disturbances in those days—that there was a peasant revolt? Already the doctrine of the equality of man and social inequality was being preached to the lower classes. In 1360 John Ball—"a mad priest in Kent," as Froissart calls him—preached such a communistic sermon as this to the sturdy yeomen of that day: "Good people, things will never go well in England so long as goods be not in common, and so long as there be villeins and gentlemen. By what right are they whom we call lords greater folk than we? On what grounds have they deserved it? Why do they hold us in serfage? If we all came of the same father and mother, of Adam and Eve, how can they say or prove that they are better than we, if it be not that they make us gain for them by our toil what they spend in their pride? They are clothed in velvet, and warm in their furs and their ermines, while we are covered with rags. They have wine and spices and fair bread; and we oatcake and straw, and water to drink. They have leisure and fine houses; we have pain and labor, the rain and wind in the fields. And yet it is of us and of our toil that these men hold their state." That is the same cry against the inequality of property and social condition which we hear to-day. And we may thank him, and men like him and with his inspiration, that the conditions of five hundred years ago have changed, and that the dawn of a better and higher humanity has broken upon us. Filled with socialism and communism as the words are, they still have a truth which appeals to every sympathetic and thoughtful man.

And it was in those early days that the old rhyme was heard all over the land:

> "When Adam delved and Eve span.
> Who was then the gentleman?"

The sermon was preached against the tyranny of property, the rhyme was full of the democracy of the coming years.

I do not imagine that the instigators of such laws as the Statute of Laborers were hard men as

men go. They could see only their side of the case. The laborer had become a necessity for them, and they rather believed that the Almighty had put him on earth for their advantage. I am afraid that something of that spirit still is left among us. The feeling still exists that the employer and capitalist can take care of and provide for the employees better than they can themselves; that [Pg 89] they should be very thankful when out of his abundance the employer builds them a library or permits them to live in some finely ordered village as he directs. But somehow the feeling is growing now that if the wage-earner had a larger and fairer share in the profits he could take care of himself better in the end and grow faster, because he would be more his own master; and that the good things now and then given him with more or less ostentation as gifts are bought with the money he really ought to have and in the future hopes to have himself.

Well, the result of such laws and the general social discontent and the levy of new taxes upon even the lower classes brought about the Peasant Revolt in 1381. Of course, the power of the upper classes, aided by the courage of Richard II, then only a boy, put down the revolt, but not until the king had promised amnesty and emancipation to the serfs. Death on the scaffold and in the field soon showed the participants how little such promises were worth. The serfs were subdued, but strife between the laborers and employers was not ended. The legislation still reflects the terror and greed of the landowners, for, in spite of all, labor was in demand and had the market at its feet. Legislation forbade "the child of any tiller of the soil to be apprenticed in a town," and the landowners "prayed Richard to ordain 'that no bondman or bondwoman shall place their children at school, as has been done, so as to advance their children in the world by their going into the church.'" But villeinage continued to disappear, and within the next hundred and fifty years it had become "an antiquated thing." The failure of the landowners to again fasten labor to the soil and to fix low wages drove their energies in a new direction. "Sheep farming required fewer hands than tillage, and the scarcity and high price of labor tended to throw more and more land into sheep farms." As personal service died away it became the interest of the lord to unite the small holdings on his estate into larger ones. The evictions consequent upon this course threw many laborers upon the market, and the sheep farms diminished the number required, while the smaller amount of holdings devoted to agriculture increased the price of food. And so it is not surprising that within the course of a comparatively few years, instead of a scarcity there was a glut of labor; that pauperism increased, and social discontent continued; that vagabondage with its dangers to society at large became a difficult problem. Indeed, the poor have always been with us, but those of us who find so much to depress us in these modern days can get new courage by looking back to those old days and can see the real progress which has been made. The whole lower class in England down to the time of Elizabeth stood looking into the face of want. Henry VIII confiscated the monasteries, but put nothing in their place, and in a [Pg 90] measure by so doing deprived the poor of some relief from the wealth of the church. But Elizabeth inaugurated a system of poor-laws which, although crude and somewhat hard, still served to ward off some of the social danger. The course of events, however, and the rise of new industries did more to make life for the laborer, the landless man, less bitter. With the discovery of America and the opening of fisheries in these western waters, and the adventurous and buccaneering voyages of Drake and his compeers, came the gradual development of manufacture, and a "more careful and constant cultivation of the land." All these were new and larger avenues for the employment of labor. By this time the laborer had grown entirely away from serfage, had been freed from the terrible grasp of a hopeless future, and the possibility of a degree of comfort and independence had come into existence. We need not linger longer over his early days. The laborer still had his peculiar trials and hardships, but he had a future. From a subject class, the terror as well as necessity of its employers, he has grown to be their equal before the law, and this by his own efforts, aided, of course, by the advance of society and the broader humanity of mankind.

The increase of manufacture brought with it a new danger to the working class as we reach our times, and brought about a state of things which gave rise to trades unions. Manufacture naturally in the beginning was carried on in a small way, but in modern times, especially as we get into this century, the small concerns grew into large ones. Instead of one man or partnership with a comparatively small amount of capital, the corporation or joint-stock company with its large aggregation of capital carries on the business of manufacture and trade. This aggregation of capital has made an entire change in the relation between employer and employee. The corporation came in the line of progress. Consolidation of capital has come to stay, and properly so, but it brought with it dangers, just as every step in advance has done. It was to meet the new dangers to the wage-earners that trades unions came into being, for trades unions and labor unions are really only organizations of labor as corporations are aggregations of capital.

When industrial establishments were small, the owner, whether in trade or manufacture, had practically absolute direction of his business. In the industrial world what corresponds to an unlimited monarchy in the political world has been the system. As establishments grew larger, the autocratic power of the owner passed to the manager acting for the owners. As one writer puts it: "Huge industrial establishments are under the unrestrained control of a single man. At his will they are set in motion; at his will they stand still; at his will capital and labor unite and [Pg 91] are fruitful; at his will they are parted and remain barren. Men come and go at his bidding. He knows no superior and recognizes no limitations. He calls an attempt at control 'dictation' and resents it with anger." That is the extreme case, and is industrial despotism. While the results doubtless are good in many cases, and the laborer receives fair and decent treatment in most cases, that is owing to the temperament or prudence and good judgment of the master and not to the system. Such a condition of things is becoming more and more modified. We have reached in many cases a condition which may be said to correspond to a monarchy with constitutional

limitations—the master is restrained in the exercise of his power by public opinion, the strength of the workingmen, and in some cases by legal limitations. The organization of boards of arbitration, and the recognition of the right of the employee to a share in the profits, are daily extending. The tendency toward giving the wage-earners a share in the business, some modified form of co-operation, is daily extending. The trend is toward what may be called industrial democracy, just as in the political world real democracy is fast becoming the universal principle, whatever the style of the government may be.

This advance in the industrial world has come about through the agitation and power of labor organizations, of which, as they exist now, trades unions were the early manifestation. The employer, as a rule, looked after his own interests mainly, and the employee alone by himself had to take what he could get and do as he was told. Just as the people, after they sunk into subjection in the earlier days, had little political power as against the nobility until they were strong enough to take it, so the laborer still would be of little account except as a more or less intelligent machine unless he had proved himself a man, with a man's aspirations and a man's energy.

Labor organizations or trades unions came into existence in England. The democratic spirit, the spirit of liberty, the Saxon spirit of independence, which wrested from kings and the nobility all the rights which the common people enjoy, has been doing in the industrial world only what it did in the political world years before.

We may say that trades unions find their prototype in the *frith guilds* or *peace guilds* of the Anglo-Saxon. A few words in general about them and their successors and the spirit pervading them, the causes of their existence and decay, will have a bearing on labor organizations, which are like them in "being founded on similar mental faculties and desires and as contemplating similar purposes."

These *frith guilds* seem to have been associations of neighbors for mutual help and protection. They replaced the older brotherhood of kinsfolk, which had existed among the German races, "by a voluntary association of neighbors for the same purposes of order and self-defense." An isolated [Pg 92] existence for a man, even a freeman, was one of danger, especially when the feudal temper of the nobles increased and the Danish incursions broke over England. The ties of kindred had become weakened, and the frith guild took the place of the family. A mutual oath bound the members together, and the monthly guild feast became the substitute for the old gathering round the family hearth. A member could call upon the guild in case of violence or wrong; when charged with crime, the guild answered for him, and when guilty, punished him; when poor, it supported him; and when dead, buried him. When these guilds were located in towns rather than in the country, they inevitably tended in time to combine, and eventually the town passed from a collection of guilds into one large guild, and we have the *town guild*. The word "town" is used in contradistinction from the word "country," just as we say "town and country," "going to town," and so on. The spirit of independence and freedom, kept alive in our town meetings here, and in our local self-government, has come down to us through those old town guilds and the boroughs of England. It is to the towns of England and not to the country that we owe much of our liberty to-day.

So these guilds in towns, by joining together and making a town guild, became quite strong communities. They made demands upon the crown itself, and took upon themselves the government of the towns where they were located. Their members were the landowners of the town, and the other people who came there to settle, no matter how numerous, had no part in the government. From being democratic in the beginning, as the frith guilds were, the towns became oligarchies.

In the course of time the differences between town and country became more marked. The town guilds began to have less and less to do with agriculture, although at first they were interested in it. The wealth in the town is turned to trade and manufacture, such as there was in those days. So, by the time of the Norman conquest, in 1066, we hear little of town guilds, but in almost every case *merchant guilds*. The *town guild* has become a *merchant guild*, although composed of the same constituency. The commercial spirit has become the ruling spirit of the town.

As time went on and life and property became safer and trade increased, the consequent accumulation of wealth in towns produced important results in the character of these municipal institutions. "In becoming a merchant guild the body of citizens who formed" the government of "the town enlarged their powers of civic legislation by applying them to the control of their internal trade." No longer confining themselves to providing for public order or protection from [Pg 93] unjust oppression or dangers from without, they began to legislate for their own immediate advancement and for their own pockets. "It became their especial business to obtain from the crown or from their lords wider commercial privileges, rights of coinage, grants of fairs, and exemptions from tolls; while within the town itself they framed regulations as to the sale and quality of goods, the control of markets, and the recovery of debts." And further, the members of the guild withdrew from the humbler trades to confine themselves to the larger business of commerce or trades requiring large capital, leaving the trades and traffic given up to their poorer neighbors. This ruling class comprised only a part of the inhabitants, only the members of the merchant guild. The great mass of the people, the artisans and the poor, the men without land, the serfs escaped from the country and gaining their freedom in the town, all had no voice in the government whatever. They lived and worked and earned their daily bread practically by permission or at least under the direct control of the merchant guild. From a simple association,

the guilds in towns had become the governing body, and a government in the hands of a few at that. From the need of protection on account of individual weakness, the members of the guilds had grown to be in need of repression; and with the demand for repression came the instrument of repression—the *craft guild*. Against the autocratic power of the merchant guild arose the craft guilds, or associations of workers in the various trades, those trades abandoned by the merchants, and these guilds "soon rose into dangerous rivalry with the original merchant guild of the town."

These craft guilds in the old English towns, in order to attain their objects, considered it necessary to compel the whole body of craftsmen belonging to the trade to join the guild of that craft or trade; and further, that the guild should have legal control over the trade itself—who should be admitted to it, and so forth. "A royal charter was indispensable for these purposes, and over the grant of these charters took place the first struggle with the merchant guild, which had till then solely exercised jurisdiction over trade within the borough." The struggle was a fierce one and long continued, but the spread of the craft guilds went steadily on, and the control of trade passed into their hands. Then the next step—a share in the government of the borough itself—was taken, and the government of the towns passed from an oligarchy into the hands of the middle classes.

The craft guild came into being just as its predecessor had, from the necessity of association for protection, and like it was democratic at first; and, again like it, became in time an oligarchy as narrow as that which it had deposed. The craft guild arose because the artisans and tradesmen had grown to a position where they could recognize the injustice and oppression of the merchant [Pg 94] guild, and were strong enough and persistent enough to assert themselves, and as long as the craft guilds were democratic in spirit and were true to the needs for which they were organized they flourished. But with age and success came narrowness and bigotry and opposition to progress. They became monopolies of employment and societies of greedy capitalists, and in England withered away before the growth of the modern vast industrial establishment.

I have ventured to give this general sketch of these guilds because the same spirit and necessities which inspired them brought the trades union into being. The trades union or labor organization was created to protect the laborer and gain for him a better position in life, to raise his standard of living. It is like the old guilds in being subject to the same dangers as they were, and when it proves false to its true objects it will pass away as did the old guilds. It will last only so long as there is a necessity for its existence, as long as it does the work it is born to do. And when it has come to deny freedom, to refuse another's rights, and to repress industry, the seeds of dissolution are already sown.

Trades unions or labor unions arose from the necessity of organization among the laborers or wage-earners if they were to hold their own against the aggregation of capital. The craft guild arose at a time when trading and manufacturing concerns were small, when the interest of both master and workman in a business were alike joined in opposition to the exactions of a superior class—the merchant guild; while the trades union came upon the field to protect the laborer against his employer. Whatever other objects and aims it may have had do not enter into my purposes in this paper. The personal relation which had existed between the master and servant, the employer and his few employees, the manufacturer and his half dozen workmen or apprentices, no longer existed when the workers became scores and hundreds, and the owner of the business was replaced by the manager or superintendent. That personal relation was in some measure a protection for both, but when that disappeared the temptation to gratify owners and stockholders with big dividends became too strong to be overcome. Against organized capital there was absolute need of organized labor, and trades unions and labor unions and such organizations came into existence.

There was no possibility of their existence until the laborer had become intellectually and socially capable of organization, and until the divine spirit of discontent drove him to association with his brother worker. During all the years from the time of his serfdom up to the time these organizations began he had been slowly growing in development and gaining something in political position, but it was not until political power came nearer and nearer to him that he [Pg 95] gained the strength to raise his standard of living, to make a stand for himself. He knew the struggle would be a hard one, for everything he gained seemed to be something taken away from those who held themselves above him and better than he.

As a rule, we are very well content to let things alone if we ourselves are fairly comfortable, and especially are we blind to another's ills if the remedy for them is found in a renunciation of part of that which we have always considered our own. There is nothing particularly new in this. We easily can imagine some worthy burgher in the olden time expostulating at the demand of the craft guild even to be allowed to exist, and I do not imagine his language varied much in spirit from the indignant disgust shown by some large employer of labor to-day when he talks of labor unions. Doubtless these unions to-day seem to him to have the same dangerous tendencies which the craft guilds were talked of as having eight hundred years ago.

If there were no wrongs to right, if selfishness did not exist, if there were a real belief in the brotherhood of man, and life were in accordance with that belief, such organizations might not be necessary, or if they existed have other aims; but until all men have an equal chance for self-development, and a chance for something more than a mere existence, labor unions or something to take their place must exist.

And so we stand to-day with labor unions and the labor problem, so called, with us. The laboring

class is discontented. Men claim as rights what their fathers would have been glad to get as favors. There are violence and bad blood and waste, and so there have been from the beginning. But there have been also injustice and oppression and greed from the beginning. While we may condemn strongly much of the violence and wrongdoing of labor organizations, we can find many extenuating circumstances. The same spirit of independence, the same desire for equal justice which animated the old guilds of England, and which have made the Englishman and those who have sprung from him the freest as well as most law-abiding people on the earth, are found within the organizations of labor. We in this country hardly can find only danger in the spirit which impels the workingman to resist every encroachment upon his rights, to strive for that better future to which he believes he is entitled. There were many things done in the youth of our history which in our manhood we regret, and I hardly think, as a nation, our own robe is so unspotted that we must draw it round us lest it be soiled by the violence of a perhaps uneducated and inadvisable but still earnest effort after higher and better conditions of life. Let us read and ponder over our histories anew, and with humble hearts try to find a better way both for the laborer and ourselves.

I have said that it was through his organization that the laborer has made the industrial and social advance he certainly has made in the last century. The trades unions, like the guilds before them, had to struggle for a legal existence, and their early days were full of violence. Dr. Brentano, in his work on Trades Unions, says: "They have fought contests quite as fierce as those of the old craftsmen against the patricians, if not fiercer. The history of their sufferings since the end of the eighteenth century, and of the privations endured for their independence, is a real record of heroism." May not we hope with him that now they may cease using the arms of violence which belong to former times and use the legal means which belong to our days? [Pg 96]

We can not approve of their violence, but let us not be unduly alarmed by it. If society becomes so ossified in its usages and habits and thinking that a newer and better thought can not get in, a nobler way of living for all be entered upon, it sometimes seems as if in the very nature of things violence must come to rend away the obstructions. I believe that labor organizations are as much the instruments of progress as the town guilds and craft guilds of old. They will do their work, and the world will be the better for it. They tend to make society more democratic industrially as well as politically, as their predecessors did, and therefore better. For what is democracy but a practical recognition of the brotherhood of man? If Christianity amounts to anything, what higher aim should we have than that?

Many students of the problems involved state that in the long run labor still does not receive its full share of the profits; that in order to keep up the standard of living which the wage-earner already has reached he must have a larger reserve fund. In other words, he must be able to save more. To do that and still live as he claims he ought, his share in the profits, his wages, must be larger than now. We can not claim that the standard is too high because admittedly it is higher than ever before. Hon. Carroll D. Wright, in a recent address, says: "Under the iron law of wages as announced by Ricardo, it [the labor question] is a struggle simply to secure barely enough of food and raiment and shelter to preserve the working physical machine, the rule being that wages ought not to be paid over the bare necessities. To-day the standard of living of the ordinary wage receiver involves margins above the iron law of from ten to fifteen per cent, out of which margin is to be found what are now called spiritual necessities, means of leisure, reading, music, recreation, etc., so that the demand of the worker in all civilized countries is for the expansion of this margin. He feels entitled to this because society has insisted upon educating him, giving him a taste for higher things, making him a social and political factor; in fact, fitting him for membership in a democratic community." [Pg 97]

Labor organizations, in spite of much extravagant language and many ill-advised acts, certainly aim at a better condition for the wage-earner. We fail to see the intelligence underlying industrial controversies because progress has been so rapid. Some of the methods of labor organizations are violent and the weapons used are in a great measure strikes and boycotts. That is industrial warfare and is as costly and wasteful and cruel in many ways as any warfare is, but very often these organizations seem to have no other method of making their power felt; no other way of bringing about a needed reform. And we can not say that all strikes have been or are necessarily wrong, except in the same way that all warfare is an evil. The very readiness to strike will effect a reform which a known weakness or lack of courage on the part of the organization would have prevented. Such an authority as John Stuart Mill says that "strikes, therefore, and the trade societies which render strikes possible, are for these various reasons not a mischievous, but, on the contrary, a valuable part of the existing machinery of society." Whether in a particular case a strike or boycott is right or wrong depends upon the facts of that case, and whether we have reached a point where strikes are no longer right, no matter what may have been the case in the past, is another question. Let us hope we are nearer that time, at any rate. It will depend upon the attitude of employers as well as employees.

Out of strikes themselves comes a remedy. Daniel J. Ryan, in his article on Arbitration, records that "for sixteen years the disputes of labor and capital in the rolling mills of England have been settled by arbitration, and it has been an era remarkably free from strikes. The Board of Arbitration for the north of England iron business was, as all efforts of this kind usually are, the outgrowth of a strike." Now, in this part of England before the formation of this board, strikes were chronic. The works in that section recently had 1,913 puddling furnaces—more than in all Pennsylvania, and half as many as in the entire United States.

The limits of this article will not allow a discussion of voluntary or involuntary arbitration, but let

me say that in the above case we see that a simple arrangement between the parties changed all the strife to peace. Will society long tolerate a continuance of industrial warfare when it has in its own hands a preventive? For its own protection will it not tell employer and laborer, "You must settle your differences quietly by mutual agreement, or, if you can not, I will settle them for you"? It says this now to the individual. Men and women are not allowed in these days to settle their rights and wrongs by brute force. That method passed away long years ago in civilized communities. And society must continue to suffer from the violence and waste of strikes until it teaches employers and workingmen and itself a higher and better way. [Pg 98]

May not it be possible that the outcome will be that associations of wage-earners are to be treated as the equals of the employer? Will not the democratic spirit of the age to come so permeate the industrial as well as the political world that the laborer and the employer will each have a share in the business they together carry on?

I have tried to make a very broad sketch of the change which has taken place in the condition of the laborer, with a consideration of some of the means by which that has come about. No longer is he a serf—no longer even the servant of a ruling class. He at length has risen to a share in the government of his town and country. No longer are laws passed against him specially, but in his favor. The laborer has become free—free to follow along the path of his predecessors, to gain full justice, but not to oppress others. Before the law at least he is the equal of his employer. I have implied at least that he has but followed the spirit which led his older brother of the middle class up from practical subjection to power. The craft guilds of the one, the labor unions of the other, are in the same line as the old town guilds. They all are manifestations of that democratic independence which seems necessary for political freedom. They all imply the capacity for organization as they all have shown its power. Let us believe that, like the old guilds, these labor organizations are helpful parts of the machinery of human progress. They force upon us the fact that there have been and are injustices which must be righted. We are beginning to learn that we can not depend upon one side alone for our political economy or our facts; that we need an organization strong enough to compel respect in order to protect those who without it would be, as they have been, helpless.

All the smoke and clash of industrial warfare seem terrifying; the innocent victims shock our sense of justice, but it is leading to the perfect peace. The true democracy—the brotherhood of man—is forcing itself upon mankind. If we in our prejudice, our selfishness, our ignorance, defy the signs of its coming, try to prevent its growth, or find only license in liberty, we shall continue to suffer all the ills which an obstruction of progress or a violation of its laws always brings with it. Is it not true that never in the history of the world has there been an agrarian rising, a peasant revolt, a labor war, that back of it we do not find as a main cause the injustice, the oppression, the selfishness of a more powerful class? And will there be perfect peace, perfect prosperity, until the divine harmony—the real brotherhood of man—is the rule of life? Wrong always breeds violence. But out of that violence, when the wrong is made right, comes peace. Massachusetts in her motto declares that "by the sword she seeks peace," and, to use Richard T. Ely's words, "the Prince of Peace proclaimed, 'Think not that I am come to send peace on earth; I came not to send peace, but a sword'; and yet truly was he called the Prince of Peace." Often is war the price of peace. And no one, no class of men, deserve their freedom unless, when all other means fail, they have the courage and energy to pay the price. [Pg 99]

Therefore, we will not be alarmed at struggles which in the end will bring about a better condition of life for all. Rather let us try to end those struggles by pushing bravely on toward the end mankind is striving for. We, with such a past as ours, must not be false to the ideal which is our birthright; we should not be incapable of finding the true way. If we will forget our merely partisan strife, our petty jealousies, our class distinctions, and have only one aim, justice for all, an equal chance for self-development for all, whether he be born rich or poor, the ruling spirit of the next century will keep America still true to her high calling, and mankind still will find in her the inspiration to raise the disheartened and lowly of other lands. The truest patriotism is broad enough to help the unfortunate everywhere, and with courage, intelligence, and a faith in true democracy we shall not fail.

THE BERING SEA CONTROVERSY ONCE MORE.

By Prof. T. C. MENDENHALL.

Mr. Clark's interesting and, on the whole, fair review of my article on Expert Testimony in the Bering Sea Controversy, printed in this journal in 1897, might be allowed to stand, without comment, as the best possible vindication of the work of the Bering Sea Commission of 1891-'92, and as strong corroborative evidence of the soundness of the position taken in the article referred to. One or two quotations which he makes, however, are placed in such relation to other parts of the paper as to imply meanings which a reading of the article as a whole will show were never intended. This is notably true of the description of the frame of mind in which a scientific man should approach or conduct any investigation, which Mr. Clark quotes, and the further statement that, unfortunately, he often fails to come up to the standard set, and especially when his own interests are involved.

It might easily be inferred that these remarks were meant to have special application to the

members of one or both Bering Sea commissions, while as a matter of fact they were a part of the general introduction, occurring some time before any reference is made to the commissions. I should greatly regret having any one understand that there was the slightest intimation of the existence of a "handsome retainer," or anything of the sort, in connection with any or all of the Bering Sea investigations. [Pg 100]

As far as the American representatives on the first commission are concerned, it is no harm to say that the pecuniary residual was unfortunately affected by the wrong sign, and this was doubtless the case as well with Dr. Jordan and his colleagues.

As to the truth of the statement regarding the "scientific expert," no evidence need be offered here, for it is furnished by every court in the land, and not a day passes that does not witness a struggle between "experts" who have nearly always started from the same premises, but whose conclusions are diametrically opposed to each other. What I do want to say is that this is quite consistent with the perfect honesty and good intent of the experts themselves. It is the result of the limitations to which the operations of the human intellect are still subjected, and it is a fact always to be reckoned with in matters of this kind. There should be no skepticism as to the honesty and frankness of Sir George Baden-Powell and Dr. George M. Dawson in assuming an attitude so opposed to that of the American commissioners in 1892.

Mr. Clark regards my article of 1897 as a "prediction of failure for the new commission," an assumption quite unjustified and unsustained by the article itself, in which the fullest recognition is shown of the great value of the work of Dr. Jordan and his colleagues. Indeed, the article was purposely prepared and published before the meeting of the second commission, that it might not seem to be in any way a criticism upon its work. Now that both commissions have made public their findings, the whole matter is easily accessible, but Mr. Clark is hardly just to the first commissioners on either side, by the slight reference he makes to their separate reports to their respective governments. A more careful study of both might have led to some modification of his views, even concerning the partition of authorship which he has ventured to make. It is no mean compliment, however, to find him admitting, in regard to the report of the American commissioners, 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." And this admission lies adjacent to his assertion that "the investigations conducted by the two commissions [of 1891] were, from a scientific point of view, of the nature of a farce." The fact is, Mr. Clark seems to have strangely misunderstood the character of the investigations which were contemplated and desired. The natural history of the fur seal was not the question submitted to the joint commission, except in so far as it specially affected seal life in Bering Sea and the measures necessary for its proper protection and preservation. [Pg 101]

"Facts, causes, and remedies" were the subjects to be considered. There is an old saying that the flavor of the pudding may often be revealed by chewing the string, and no long and exhaustive investigation was necessary to enable the American commissioners to arrive at what Mr. Clark admits to be the "facts, causes, and remedies" for the Bering Sea problem. Not many weeks were occupied in the field, it is true, for the commission was delayed in its appointment and notification, and the season was nearly over when it reached the islands. But, as Mr. Clark justly remarks, one member of the commission, Dr. Merriam, was already exceptionally well informed concerning the habits of the fur seal, and some things may be so in evidence that even a physicist can see them.

It is true that the *joint* report of the commission of 1891-'92 was meager, and the explanation lies close at hand in the unwillingness of the American commissioners to swerve from what they were convinced was absolutely true. Mr. Clark will look in vain for the "handwriting of diplomacy mingled with that of science," for the appearance of which in the report of the commission of 1897 he offers apologies, except, indeed, it be the diplomacy of going straight at the facts without concealment or evasion, on which Americans have sometimes prided themselves.

The joint report was limited to that, and only that, on which the commissioners were actually agreed, and the American commissioners have explained in their separate report that had they been willing to concede certain points the joint report would have been greatly augmented in volume. Mr. Clark has reviewed the conclusions of the commission of 1897, which he justly considers a most important and valuable document. It has not escaped his attention that in a number of the paragraphs of this report the American commissioners have committed themselves to the approval of several doubtful statements, such as that "the pelagic industry is conducted in an orderly manner, and in a spirit of acquiescence in the limitations imposed by law"; that a certain number of females may be killed without involving the actual diminution of the herd; the "tendency toward equilibrium theory"; that the herd is still far from a stage that threatens extermination, and others. These statements he excuses as "balm for the wounded feelings of the pelagic sealer"; "a concession to diplomacy"; "a diplomatic concession to take the sting out of the real admission"; "another concession to diplomacy," etc. I do not wish to be understood as questioning the necessity or wisdom of inserting these paragraphs in the joint report, but is it not a little strange that with them in, and apologizing for them as he does, Mr. Clark should have selected this as a model of what the report of a scientific commission ought to be and sufficient of itself to forever fix the value of the scientific expert in the settlement of government disputes? As I have already intimated, no one appreciates more highly than I the great work done by Dr. Jordan and his associates in the study of the natural history of the seal. May not the work of the two commissions, as *bearing on the problem of the fur-seal industry*, be summed up about as follows?—The report of the American members of the first commission related facts, declared [Pg 102]

causes, and proposed remedies. The American case at the Paris arbitration rested on these. As almost universally happens, arbitration resulted in compromise, unsatisfactory to both parties, and, as has since turned out, decidedly unfavorable to one. The commission of 1897 has made a joint report of considerable length and much importance, in which the "facts, causes, and remedies" of the report of 1892 are in a sense confirmed, but with a number of concessions that do not strengthen the American contention regarding pelagic sealing, the justice of which seems to be admitted by Mr. Clark. But the practical question is, What has been the effect of either or both of these commissions upon the fur-seal industry? It would be unkind to press this question upon one who characterizes the work of the first commission as above quoted, and who speaks of the second as having, after being in joint session one week, "concluded its labors, reaching a full and satisfactory agreement." If he really wishes to know what progress is being made under such an agreeable state of affairs, let him inquire of the International Joint Commission, which is endeavoring to arrange all outstanding differences between this country and Canada.

CAUSES AND PREVENTION OF INSANITY.

By SMITH BAKER, M. D.

It is being found out that cases of insanity may of themselves fall naturally into two classes: the first comprising those who get well, and the second those who do not. To the first class belong the deliriums of fevers and other like diseases, and also certain acute manias and melancholias and the so-called generalized insanities. In the second class are included the insanities which last indefinitely, or, if seemingly cured, which, in the proportion of from twelve to fourteen per cent, come back again one or more times, and finally do not recover. Says Regis: "Out of all forms of mental alienation or insanity only the generalized types—i. e., mania and melancholia—are curable. The systematized insanities are essentially chronic and recover only exceptionally" [Pg 103] (Practical Manual of Mental Medicine, page 54). The latter are known by such specific names as paranoia, chronic mania, chronic melancholia, insanity of doubt, circular insanity, hereditary insanity, and the like. What makes such a division of insanities into these two classes significant is not only that those of the first class get well and the others do not, but that, generally speaking, these latter are so founded in the constitution of the individual that they can not recover, let everything as yet possible be done for them as it may. Probably there are exceptions to this; but, if so, they are not very often met with. All these cases seem to be doomed from the very first either to follow a slowly downward grade to the very end, or else to manifest a series of alternate better and worse stages, which, while giving rise to bright hopes of ultimate recovery, nevertheless just as surely tend more or less rapidly downward, in pretty strict accordance with the rule. In passing, it may be noted that not only the tragedy of such alternations of emphatic despair and delusive hope constitutes not the least of the wretchedness involved in the history of these cases, but that it is by no means the easiest thing about them to manage; for, in the earlier stages, it is almost impossible to make associates or relatives understand the full meaning of the disease, or to take a correct view of its probable outcome. Even much later on they cling to the possibility of recovery, which is as delusive as it is painful, for the disease goes on, nevertheless, with varying stride and manifestation, until it finally becomes evident that hope is almost absolutely without any real foundation.

Now, when a case of persistent or recurrent but really irrecoverable insanity is studied, with respect not only to the life of the individual affected but to the lives of his ancestors, both remote and near, and in sufficient detail, it is seen that the causes of the present breakdown have been long and surely operative in those from whom he has inherited certain unfavorable characteristics, and at whose hands he has had his bringing up and education; and this even much more weightily than in himself or the life which he has lived. So far as the patient's own responsible life is concerned, the common causes, such as accident, infection, overwork, mental and moral strain—in fact, all the usual forms of stress—have, of course, been just as variously to blame, and in just the same way as they have been in the production of insanities in other individuals who finally recover. But even in respect to these latter, it probably may be most frequently discovered that the harmful effects of certain so-called exciting causes have been experienced, not because of the common emergencies and exigencies of life so much as because of some peculiar but unrevealed characteristics which have produced and maintained a sort of vicious maelstrom into which have been attracted all the detrimental influences that have [Pg 104] accidentally or intentionally come within reach. For instance, such persons are almost always predetermined to grow up into harmful bodily and mental habits. Says Peterson: "Among all degenerates there is a taste or appetite for certain foods or drugs which tend to favor their dissolution (alcohol, morphine, cocaine, and the like)" (State Hospitals Bulletin, vol. i, p. 372). So also are they apt to be wrongly educated, or to draw around them harmful associates; to develop the most wearying and exhausting enthusiasms, or to choose a business and place of residence to which they are not adapted; to marry some one who will chiefly wear and burden them; to assume responsibilities and positions out of keeping with their native strength and endurance; in fact, to get entangled in all the affairs of life in just the very way calculated to bring about the one thing which should have been, by every known means, sought to be avoided. It is in this way that "physiological fate" unconsciously spins the web which ultimately fastens its own doom. That such a pernicious course should eventually result in disaster is no wonder at all; for when investigated deeply and comprehensively enough, it is seen that of all possible persons, such are,

by birth, the very least calculated to endure the wear and tear thus engendered and maintained; while, as scarcely a word is ever heard and scarcely an effort is ever made as to the necessity for so training and educating and inspiring these people that the defects of heredity will be remedied, it follows that the most ordinary ventures of commonplace life are by far more dangerous to them than to their better-endowed fellows.[36] When properly endowed by heredity, and adequately bred and educated, it is almost beyond wonder, the amount and character of persistent stress which human nature can triumphantly endure. When otherwise, however, it is no wonder at all that sooner or later serious breakdown comes to pass.

The importance of saying this is obvious when we consider that as a rule active life is allowed to be entered upon without adequate preparation and intelligent adaptation of either bodily or mental strength to the stress that is likely to be encountered. Always it is asked, if anything is asked at all, "Has he the skill to make his way?" instead of, "Has he the prospective endurance required by what he purposes undertaking?" while, if the latter chances to be considered at all, the conclusion is most usually based upon present appearances rather than upon past tendencies or actual developments. Elsewhere I have said: "In almost every instance (of breakdown) I have [Pg 105] come across the result of some big educational blunder, owing either to the system in vogue or else to those who execute it." (See Steps toward Insanity, New York Medical Journal, August 14, 1897.)

There is one fact about heredity which seems not to be commonly considered—namely, that each individual is really the descendant of not only his immediate parents, but of the two lines of ancestry indefinitely far back and widespread. Thus, in many instances, the dominating characteristics are not those of father and mother, but of grandparents, or of some other antecedent or collateral relatives instead. In fact, each individual in its development from the germ to adulthood passes through not only many animal forms, but through many ancestral phases of character as well. And, as in the first case, the size and strength of adult physical features depend on the stage at which growth becomes abnormally extended, perverted, or arrested, so, with regard to mental and moral qualities and their persistence under stress, the outcome mostly if not entirely depends upon the extent to which they are allowed or constrained to develop, or the reverse. Here we often see the absolutely limiting influence of "atavism," or what is characterized as "reversion," to generations further removed than the parental, but which really is the result of an exaggeration or a stoppage, or a perversion of development before the stage of parental dominance is finally reached. In this way the featural and mental characteristics of relatives as far removed as great-grandparents or great-granduncles, as well as grandparents and uncles, are seen to appear in children even when young, to be finally either accentuated and made prominent, or else possibly outgrown or otherwise overcome as the years go by, and as the later parental determining powers and the corresponding environment come to manifest their influence.

With this view of heredity in mind, it is easy to see how the real basis of every mental breakdown may be and probably is simply an overdoing or perversion or other irregularity at some premature or "atavistic" stage of development; and that anything and everything which may have had to do in causing this should be considered as a primary step toward the insanity itself. But easy as it is to see this theoretically, it does not necessarily follow that it is easy to get hold of the real facts or to help the matter in any given case. Many times families are loath to reveal things which might indicate such a basis of the dreaded disease. Many times they do not recognize the necessity of telling what they would otherwise be willing enough to reveal. Many things are absolutely forgotten or have been at best only vaguely comprehended. Sometimes conscious deception is practiced; at others, the party who really has known the facts is dead or is otherwise inaccessible. But more often, and more interfering still, is the unconscious perversion of facts, [Pg 106] either from the false meanings which, owing to specific views and predilections and fears, are read into them, not only by the laity, but often by the profession, or else from the wrong deductions derived from actual facts clearly understood. Try as one may, it is often most difficult to get a sufficient number of clearly defined facts to enable even the most expert to form a true and comprehensive idea of the case in hand.[37] This leads to the remark that what is now absolutely needed is some form of record-keeping which shall become a general practice on the part of heads of families and their physicians, and which may be handed down from generation to generation; and not only this, but that these shall be so accurately and fully kept that they may be worthy of consideration as the best and in fact the only basis of a scientific generalization in case of mental or moral emergency. That people as a rule would probably resent this, as constituting an undue interference with the sanctity of personal and family rights, while undoubtedly rendering it practically nugatory for the time being, does not in any good sense militate against either the scientific need or the great good which would accrue from the use of such family records faithfully and intelligently kept. It is encouraging to note that already the way for such records is being opened in the demands made by the various *questionnaires* sent out by Dr. G. Stanley Hall and others who are interested in the scientific study of children. (See various issues of the American Journal of Psychology, and of the Pedagogical Seminary, for pertinent suggestions and results. Also an article by Dr. William H. Thomson, in the Yale Medical Journal for April, 1898.) Much more useful and in general satisfactory would this be than the blind staggering after elusory causation now so universally and yet so futilely pursued.

And the same may be said with reference to statistics as commonly tabulated. These having reference but to the surface showings, the after-the-mischief-is-done results, and so often obtained under misleading constraint or other unfavorable influences, are scarcely capable of even hinting the significance of real conditions, and especially of tendencies that have existed

antecedent to the individual breakdown. For instance, such statistics as those compiled by Dr. Wise (see State Hospitals Bulletin, vol. i, page 157), when subjected to the requirements of an accurate causative consideration, easily lend themselves to the criticism made by the author himself, who says, "The careful inquirer can receive no reliable information from the study of insane hospital statistics except the bare fact of the number of insane persons under care and [Pg 107] treatment." Yet a glance at his tables shows that forty-two per cent of the cases admitted to the New York State hospitals for the year ending September 30, 1895, are to be noted as suffering from constitutional degeneracies, and so presumably to be incurable. The more than twenty per cent of cases of insanity reported to have had hereditary antecedents, although undoubtedly as accurate as possible under the circumstances, merely chronicle the more obvious matters, and must necessarily have left out of account all the less obvious but in many respects even more important ones. And so with all the other series thus far published. They are good as indicating where we are to look for some of the steps toward insanity, but for the most part they are quite inadequate for a basis of comprehensive discussion or anything like accurate conclusion.

The pressing need, then, is that there shall be obtained a series of statistics which shall be founded upon the most definite, penetrating, and far-reaching studies of cases that it is possible for the trained scientist, with the help of an intelligent, willing laity, to make. In this respect it may be said that the assistance of the latter is just as essential as the painstaking devotion of the former; for it is upon the facts which an intelligent laity can observe and report that the scientist can bring his training to bear in such a way as to arrive eventually at accurate and therefore most useful generalizations. But such concurrent observation and study will never be until the public shall have come to look upon insanity as merely an unfortunate disease instead of a stigmatized disgrace, which, with certain exceptions, it should not be considered to be. Nor will this be the case until professional examiners in lunacy shall regularly ask for such family records, and thus create a need for their being made. When both the public as well as the profession lay aside entirely the common notions of a transcendental origin of insanity, and set to work to study the perfectly natural steps through which degeneration and breakdown eventually come to be, all will see the desirability of such health records being accurately and fully kept, not only as a help toward determining the nature and prospects of any given case, but also toward preventing the development of those constitutional tendencies which lead to trouble, as well as in helping on those that provide against it.

When we come to study the causes of insanity with a view to successfully preventing it, we are led to the supposition that the nearer to very first steps we can push our investigations the greater will be our service. Remembering that the well-born, well-bred personality generally bears almost every sort of stress with comparative impunity, it becomes us to ask just how does the opposite—the ill-born, ill-bred—constitution come so to be, and hence to break down so [Pg 108] easily. Certainly, the weak, easily breaking strains must have their origin and growth just as definitely as the more enduring ones, and if we can get an accurate notion of such origin and the conditions of subsequent growth, it seems probable that useful knowledge will thus be attained.

With this object in view an investigation was undertaken which should cover the life histories of a series of families with sufficient detail and extension to warrant at least tentative conclusions as well as also to indicate probable lines for future work. So far as possible, inquiries were pushed along collateral as well as direct lines of ancestry; and not only ill health but common habits and experiences were, so far as possible, given the consideration strictly their due. In every way the attempt was made to properly estimate the factors appertaining to the more intimate personal life as well as those that were more obvious and impersonal. Often, however, the completed record proved to be more or less broken; more often still, important items—the most important of all, in fact—could only be obtained under promise of absolute secrecy as to future use. So, as matters of absolute science, the following conclusions must stand chiefly as challenges for future confirmation or change. But, so far as they can be allowed to go, they may be accepted as pretty thoroughly based in ascertained fact and legitimate generalization.

The very first conclusion, so far as the natural history of the steps toward insanity is concerned, is that the weak constitutional strands and tendencies have their beginnings in those ancestral marriages which, chiefly for educational reasons, I have chosen to call "unphysiological."[38] By an unphysiological marriage one need not mean a marriage between people obviously deformed or imbecile or insane, or otherwise permanently unfitted, but rather between people who are found to be not well adapted to each other in some important sense. Thus, too great physical disproportion; too great disparity of age, or of temperament, or of family or of natural tendencies; or, on the other hand, too near a sameness, either through consanguinity or other sources; or too fixed constitutional characteristics; or even too great differences of education, religion, taste, or ambition. In fact, it seems probable that anything and everything which difficultly amalgamates in marriage, and as surely fails to blend in progeny, may be considered as unphysiological in this connection. As I have said elsewhere: "The parties entering into such an unphysiological marriage may both be normal individually, but yet not physiologically marriageable, because they are either too distantly or too nearly, or in fact too unphysiologically, related, either physically or psychically. In such cases the ultimate outcome is almost absolutely certain, and is noted chiefly [Pg 109] by a definite class of tensions and reactions of both mind and body which invariably impress themselves upon progeny, and which for the most part are made obvious in this particular way. No matter how unphysiological such marriages may be, however, they do not necessarily or very often result in the evolution of insanity in the parties contracting them, but rather they do lay the foundation of degenerative tendencies which almost invariably predetermine the development of this affection in more or less remote succeeding generations. Nor do the children of such

marriages necessarily or generally become insane, although they sometimes do; but, impressed as these are by the degenerative malnutritions and tensions and reactions of their parents, they tend to exhibit arrests and eccentricities of development, which in turn become intensified in the next, and again, in turn, in all the generations following, until the instability becomes so marked that explosion occurs. In passing, it may be said that the most frequent source of the initiatory tensions and reactions resulting from unphysiological marriage is undoubtedly found in abnormal cohabitation, and the unrest and unsatisfaction and exhaustion resulting therefrom. Such a condition of things begets in perfectly normal people an irritating, nagging, exhausting, persistent erethism, which in time involves the whole organism and deflects it from its norm. Two people enmeshed in such a bond always go to excesses and irregularities, either in abstinence or indulgence; or, if not this, then the whole matter becomes aversional, with straining antipathy, perverting practices, and ideational distrusts and loathings more and more predominating. No wonder that such people predetermine succeeding generations to abnormal sensitiveness, irregular growth, and erratic manifestations in both mental and physical spheres." (See New York Medical Journal for August 14, 1897; also Journal of Nervous and Mental Diseases, vol. xvii, page 669.)

Now, the outcome of such marriages seems to be a vitiated stream of tendency, which carries with it in its progress from generation to generation certain elements which predetermine to still fuller vitiation, even with incurable insanity, as noted above. Thus, people endowed with such natural characteristics, being altogether too prone to gravitate toward each other, eventually marry, and thus emphasize in progeny the vitiation already doubly initiated. Nature's course demands that such people marry, if at all, into the healthiest, most corrective stock possible. But here immediately there arises not only a scientific prohibition, but an ethical question which should be heeded: Should such people really marry even the best of stock, with the probability of thus vitiating a stream which until this time has evidently been becoming clearer and stronger? [Pg 110] Again, people who are constitutionally tending to mental breakdown are very apt to load themselves down with duties and get themselves into situations which must necessarily prove to be too onerous and too perplexing for their poorly developed strength and skill. Of course, circumstances often require this. Many times, however, there is a kind of impulsive restlessness coupled with a short-sighted optimism, both constitutional, which, altogether more than ordinary circumstances, are to blame for undue assumption of work or care, and whose effect is, perhaps, best seen in the persistent tendency of such people to originate and perpetuate exhausting habits, both of mind and body. Thus, the habit of self-poisoning from poorly digested and poorly assimilated food is easily acquired by such people, and always becomes a source of progressive brain starvation and often of consequent mental breakdown. Says Dr. A. S. Thayer (Journal of Medicine and Science, vol. iii, page 173), "There is ground for belief that exhaustion—fatigue—is dependent upon poisoning of the cells of the brain, muscles, and other tissues by the waste products of functional activity."[39] Again, as already noted, perversions of the natural instincts—of appetite for food, of desire for gain, of social or other ambitions, and especially of the sexual impulse and its habitual indulgence—fasten themselves upon such individuals with a permanence and destructiveness that must almost of necessity lead to disaster.[40] And so we may see that as a most natural, although often a far-removed, result of unphysiological marriages, proceeding through generations which have been thus predestinated to weakening choices and practices, insanity finally appears to mark the ultimate extent both of the mental disorganization and bodily inefficiency, which extent is owing not only to the original initiating steps, but also to subsequent stages of causation, progressively developed from generation to generation.

Another great source of vitiation of the stream of tendency is found in two people who marry in a truly enough physiological sense, but who find or force themselves in lives of wear and tear which progressively unfit them for childbearing and child nurture. Poorly calculated ambitions, unexpected difficulties to be surmounted, depressing oppositions, with perhaps more or less actual disease or accident, largely account for this in a general way. Obviously, during the child-rearing age, the effect of what parents are obliged to endure and execute upon the fortunes of progeny becomes a matter of far-reaching importance. That anything which persistently exhausts or overstrains the parents must tell in the later dynamic tendency and development is premised [Pg 111] at least by certain recent studies, especially those of Hodge on the influence of fatigue, and of Van Gieson on the effects of exhaustion and intoxication upon the nervous elements. (See also Peterson, *op. cit.*) In no sense can parents be said to live for themselves chiefly. Always the influence of their own health, happiness, and prosperity upon their children should be remembered, and should be made as constructive as possible. That this can be consciously attempted with commensurate results is more or less evidenced not only by common observation but by investigation. Not, however, in the sense that parents are always able to endow children with some particular, much-wished-for characteristic, as so many suppose—for it must be remembered that perhaps pretty fixed tendencies for several generations may have to be overcome and reversed before such special results can be obtained, but in the much better sense of giving such an impetus healthward and strengthward and lifeward as may later on be the beginning of a constitutional foundation that shall support many generations of full health and longevity.

If, then, the first steps—and, generally speaking, the most important steps—are discovered in the unphysiological marriage and its influence upon the bearing and rearing of progeny, then it is obvious enough that prevention of incurable insanity should begin with giving adequate attention to this phase of the subject, and this first and emphatically. Already the law says that certain peculiarly afflicted individuals can not marry; and probably this is about as far as the law can

helpfully go until, at least, public intelligence as well as private sentiment will sustain it in going further. So we must look to these latter—a widespread intelligence and a corresponding earnest sentiment founded upon such intelligence—for the means of making progress toward the prevention of insanity. But how can this needed knowledge and helpful sentiment come to be? Certainly not by perpetuating the present notions of so-called "modesty" and "purity," which, as now held, must always interfere with the study and practice necessary for ascertaining the truth, and for applying it to the needs of race-building. The time ought to come soon, very soon, when matters of such serious content shall not be so absolutely subject to the dominance of conventionality and guesswork and recklessness as now, but shall instead be subject to the sway of accurate science and its careful adaptation to human conditions. Every marriage now is at best but an experiment—blind and chance-taking often, in a most wasteful and dangerous sense. Let it remain, if it must, an experiment still, but one which shall be henceforth conducted with such foresight and skill, and withal with such intelligent purpose, as shall certainly point to improved results from generation to generation. Experience shows that it is comparatively easy to [Pg 112] ascertain what marriages, generally speaking, are prone to result in obviously vitiated progeny; or if not in these, then, to some extent at least, in the progeny which, being unnaturally constituted, are prone to develop their weaker strands of personality, and so to break down in the end. But to this course neither prudery nor superstition nor selfishness will ever assent; it must be pursued in spite of these, and by the only method which science now recognizes—namely, accurate observation, careful record, and the most comprehensive, skillful comparison, all in order that truthful inductions may be finally secured. That parents should train up their children to look forward to marriage not as the acme of personal indulgence and satisfaction, but as a most responsible partnership for the developmental keeping of unborn fortunes, and the proper nurturing of the children that may come to them, is no longer speculation, but a science-founded fact. Undoubtedly the highest state of adult satisfaction will always be closely associated with what may be characterized as child completion. Moreover, that an educational system which so thoroughly ignores this most important of all educational subjects must, in time, be subjected to the criticism which science may justly develop, is amply borne out by the cases studied. Often, indeed, has it appeared that had a modicum of real knowledge been at hand, most disastrous results would naturally have been obviated. Educators lead the day; why not they lead in directions which shall most truly correct the results of physiological ignorance and daring? That no man or woman should go forth from college with such vital knowledge unlearned is probably the first and most important means of preventing incurable insanity conceivable; and that these in turn should never hesitate to diffuse popularly that which they have been so favored in the learning, implies a duty which the intelligence itself makes clear.

So, too, if persistent overstrain and exhaustion of parents, either prospective or actual, leads directly to starvation of their own structural elements, how probable that the initiating and bearing and nurturing of children is to a like extent detrimentally interfered with in any given case through the development of an "erratic cell growth." Certain it is that completeness of development depends on two things—namely, nutrition and exercise. In a biological sense both these are dependent upon a right adjustment of supply to demand. Hence starvation or engorgement, inactivity or overwork, each may lead to the same dynamic result—that is to say, to an interference with the proper growth of the organism. That due heed, then, should always be given to the necessary health preservation of those who essay to become parents, not only in preparation for but during the whole so-called childbearing period, is so scientifically deducible [Pg 113] that it may be for all practical purposes considered as axiomatic. The way to have healthy, long-lived, and happy children is for parents to be healthful and intelligently careful themselves; while the whole science of health must eventually consist in the science of such symmetrical and high development as will enable individuals to endure necessary strain, resist disease, and rapidly and fully recover from accident and infection.

SKETCH OF WILLIAM PENGELLY.

The name of William Pengelly is most closely associated with the explorations of caves in England containing relics of men together with the remains of extinct animals, the results of which, confirming similar conclusions that had been reached in France, convinced English geologists of man's extreme antiquity. Speaking of him at the time of his death as one of the last survivors of the heroes who laid the foundation of geological science, Prof. T. G. Bonney said, "He has left behind an example of what one man can do in advancing knowledge by energy and perseverance."

William Pengelly was born at East Looe, a fishing village in Cornwall, England, January 12, 1812, and died in Torquay, March 16, 1894. The name of Pengelly is not uncommon in Cornwall, and has figured in English history—among others, in the person of Sir Thomas Pengelly, who was chief baron of the exchequer, and left certain sums for the discharge of debtors from the jails of Bodmin and Launceston. His father was captain of a small coasting vessel, and he acquired a strong attachment to the sea. He was sent to the Dame's School in his native village when very young, and before he was five years old had made so rapid progress that his mother applied to the master of a school for larger boys to receive him as a pupil. The master declined to take him, but, hearing him reading as he passed the door of the house not long afterward, concluded to grant the mother's request. At school he soon gained such a reputation for scholarship that the

boys made him spend all his play hours helping them in their lessons. His school days ended when he was twelve years old, and he accompanied his father to sea, making, however, voyages that were seldom more than three days long, most of the work of which consisted in taking in and taking out cargo. The sailors soon discovered his clerkly gifts and employed him to write their letters, but did not so well appreciate his excellent conversational powers. On "tailoring days" it was understood that his clothes should be repaired for him, while he read aloud for the general benefit, and the sailors would amuse themselves by finding solutions to questions in [Pg 114] Walkingham's Arithmetic. His seafaring life closed in his sixteenth year, when the death of a brother made it desirable that he should remain at home.

Though working hard all the day for a mere support, young Pengelly managed to spend several hours every night in study, seeking to master mathematics. He had no tutor and no really good text-books, but made such progress in his studies that in a comparatively short time he became "a mathematical tutor of no mean order." He bought his first Euclid of a peddler who occasionally visited the place; then, having saved up a little money for the purpose, it was a happy day for him when he walked thirty miles to Devonport and back, bearing, on his return, twenty volumes in a bundle over his shoulder; among them were the works of some of the standard authors, for he cultivated a literary as well as a mathematical taste.

He received his first lesson in geology while he was still a sailor boy, at Lyme Regis—a spot exceedingly rich in fossils. A laborer whom he was observing broke a stone, the opening of which disclosed a fine ammonite. To his question as to what the fossil was, the laborer replied that if he had read his Bible he would have known; that there was once a flood that covered all the world; the things that were drowned were buried in the mud, and this was a snake which had suffered that fate. "A snake! but where's his head?" He was again referred to the Bible, which would tell him why the snakes in the rocks had no heads. "We're told there that the seed of the woman shall bruise the serpent's head. That's how 'tis." The second lesson came a few years later, in a reading club of which Pengelly was a member. They were reading Dick's Christian Philosopher, and came to a geological section, when the reader remarked that "as geology was very likely to be extremely dry, and as many good people thought it dangerous if not decidedly infidel in its teachings, he would propose that the selection should not be read. This was passed by acclamation, and the reader passed on to astronomy."

While still young, Pengelly removed to Torquay, where he spent the remainder of his life. Shortly after arriving there, he opened a small day school on the Pestalozzian system, into which he introduced the novelty of the use of chalk and the blackboard in giving instruction. Beginning with six pupils, the school grew rapidly. He had private pupils, too, and in 1846 these had become so numerous that he gave up his school, and as a special tutor in mathematics and the natural sciences found his life occupation. Some of his pupils became distinguished in after life; while others, like the two Russian princes, nephews of the Czar Alexander II, and Princess Mary, of the Netherlands, all of whom became much attached to him, were famous by reason of their position. His attention was brought for a third time to geology while looking over some books [Pg 115] which he thought might be useful to his pupils, when he found one published by the brothers Chambers, which contained a chapter on that science. This was not much, but it was enough to inform him how much had already been done in geology, and, perhaps, to give him a hint of some of the possibilities that lay in it. From this time on, he was ardently interested in geology. The journal of his first visit to London and the British Museum, in 1843, attests how he was becoming absorbed in it. He spent his holidays in geological explorations and in excursions which gradually grew larger, until his position as a geologist was recognized, and he became an authority respecting all points and phenomena which had come under his personal knowledge. A hint dropped to him by Professor Jameson as he was about to visit the Isle of Arran taught him to make his notes of observations on the spot, and greatly helped, his daughter Hester observes in the biography on which we have drawn very largely, "to form those habits of extreme accuracy which characterized all his scientific work."

In 1837 Mr. Pengelly assisted in the reorganization of the Torquay Mechanics' Institute, with which he maintained a connection for more than twenty years, and before which he delivered many lectures. In 1844 he participated in the organization of the Torquay Natural History Society, of which he became, in 1851, honorary secretary, and remained so for more than thirty-nine years. "Under his guidance it became a scientific power in the country. Year after year he lectured there, tincturing the locality with his own enthusiasm; and from the society there ultimately sprang the museum in Babbacombe Road, with its admirable collections."

His lectures, delivered gratuitously at Torquay, were very popular, and were attended by large audiences. The fame of them spread, and he was called to other places—Exeter, Exmouth, and larger towns and farther off, and to the great learned societies—where he lectured, always with success, and to the satisfaction and delight of his audiences. "Those persons living, and they are many," says Mr. F. S. Ellis in the preface to Hester Pengelly's biography of her father, "who had the good fortune to hear Pengelly lecture will bear ready witness to the complete mastery he always had of his subject, and of the faculty of imparting his knowledge. Even when speaking upon abstruse subjects to a mixed audience, he would make the matter perfectly clear without in any degree appearing to talk down to the capacity of those he was addressing.... His manner was no less pleasing and attractive than the language in which he clothed his ideas was grateful to the ear." Geology and astronomy furnished the subjects of the lectures.

It would be impracticable in a brief sketch to follow the detail of Pengelly's geological [Pg 116] investigations previous to his engaging in systematic cave exploration. They embraced fields

chiefly in Devonshire and Cornwall, and afforded subjects for correspondence and discussion with many of the most eminent British geologists, and some of other countries than England. A study of some fossil fish, first observed by Mr. Charles W. Peach in Cornwall, furnished the occasion for one of his first recorded papers, On the Ichthyolites of East Cornwall, in the Transactions of the Royal Geological Society of East Cornwall, 1849-'50; and a single volume—the seventh—of these Transactions contains nine of his papers. Another subject of interest was the beekites, curious formations of chalcedonic silica on the limestone fragments in the New Red Sandstone of Devonshire, first observed by Dr. Beek, of Bristol, concerning which he read a paper at the Cheltenham meeting of the British Association, the first which he attended, in 1856. In 1860 he completed the formation of a collection of Devonian fossils from Devon and Cornwall, which was presented by the Baroness Burdett-Coutts to the new museum of the University of Oxford, in connection with the foundation of a geological scholarship, and was named "the Pengelly Collection."

The first of the more important geological researches with which Pengelly's name is intimately associated was the exploration of the peculiar formation at Bovey Tracey, for the identification of its fossils and the determination of its age. The plain in which the formation lay had an aspect suggesting the basin of an ancient lake, and its deposits, "very different from the solid rocks of the surrounding hills," confirmed the suggestion. They consisted of gravels, sands, and clays, distinctly stratified, with seams of lignite, for which they had been worked. The pits had already attracted some notice, and the deposits had been mentioned in scientific literature, but very little had been learned concerning their age. In 1860 the subject was mentioned by the late Dr. Falconer, an eminent paleontologist, to Miss Burdett-Coutts as one the investigation of which would be a boon to science. Miss Coutts supplied the money that was needed, and the direction of the systematic investigation was intrusted to Pengelly; on learning which, Sir Charles Lyell wrote to him: "I am very glad of the prospect of our knowing something of the Bovey coal plants. It is almost a reproach to English geology that they have been so little explored, as they are perhaps the only fossils of the Tertiary period to which they belong." In order to determine accurately the nature, thickness, and order of the successive beds, and to make a satisfactory collection of fossils, a new section of the deposit was made, measuring one hundred and twenty-five feet, down to the bottom of a seam of lignite four feet in thickness, the "last bed" of the workmen, but not at the actual base of the deposit. Thirteen of the thirty-one beds of lignite [Pg 117] which were cut through, and two of the beds of clay, yielded distinguishable plant remains. These were sent to Dr. Oswald Heer, of Switzerland, for examination; and he determined from the collection fifty species, including ferns, conifers, figs, cinnamon trees, an oak, a laurel, vines, andromedas, a bilberry, a gardenia, a water lily, and some leguminous plants. Heer referred the group to the Lower Miocene period, but some modification was afterward made in this determination in the light of a fuller knowledge of the Tertiary flora. The deposits and work at Bovey Tracey were the subject of a memoir to the Royal Society by Sir Charles Lyell; and Dr. Heer's account of his work—The Fossil Flora of Bovey Tracey—was published in 1863.

While this investigation was going on, Lyell was preparing the fifth edition of his Manual of Geology. He invited Pengelly to suggest corrections to the text, saying that, besides positive mistakes, he would "be glad of any hints and suggestions made freely, which your knowledge of the manner in which beginners are struck may enable you to send us." The criticisms supplied by Mr. Pengelly were adopted by Lyell except where they had already been made unnecessary.

On the accidental discovery by workmen, in 1858, of a cavern in Windmill Hill, overhanging the town of Brixham, Pengelly at once thought of finding what was in it, and what story it might have to tell. He visited the place and applied to the owner for permission to explore it in behalf of the Torquay Natural History Society. But on consultation with Dr. Hugh Falconer it was decided that as that society probably had not means sufficient to bear the expense of the exploration, the Royal and Geographical Societies should be applied to for a grant. This was obtained, and the work was carried on under the superintendence of Professor Prestwich and Mr. Pengelly, on whom, as a resident of the place, the burden substantially fell. The decision to explore the cave was brought about largely by the fact that it was a virgin cave which had been inaccessibly closed during an incalculably long period, the last previous event in its history having been the introduction of a reindeer antler, which was found attached to the upper surface of the stalagmitic floor. It was therefore free from the objection urged against Kent's Cavern that, having been long known and open, it had probably been ransacked again and again. A thorough method of exploration was determined upon, beginning with the examination and removal of the stalagmitic floor; after which the upper bed should be dealt with in a similar manner horizontally throughout the entire length of the cavern, or so far as practicable; then the next lower bed, and so on, till all the deposits had been removed. By this method the general stratigraphical order of [Pg 118] the deposits and their characteristics could be learned, all their fossils secured, and the highest possible exactness attained. The excavations were continued through twelve months, at the end of which the cave had been practically emptied. Besides furnishing interesting indications relative to its physical history, the cave yielded sixteen hundred and twenty-one bones and thirty-six flints. While most of the flints were flakes, some of which possibly might not be artificial, three were fairly well made implements of paleolithic type; and it was therefore concluded that man either frequented or at any rate sometimes entered the Brixham Cave while Devonshire was inhabited by various mammals which are now extinct. Previous to the execution of this work, all geological evidence as to the antiquity of man had been received, even by English geologists of the first rank, with what Pengelly called apathy and skepticism. After the work it soon became evident, Pengelly said in an address to the Section of Anthropology of the British Association, in 1883, that this geological apathy had been more apparent than real. "In fact, geologists were

found to have been not so much disinclined to entertain the question of human antiquity, as to doubt the trustworthiness of the evidence which had previously been offered to them on the subject." The discoveries are thought to have had a considerable share in disposing Mr. Prestwich to undertake the investigation of the remains at Amiens and Abbeville in France and Hoxne in England, "which added to his own great reputation and rescued M. Boucher de Perthes from undeserved neglect." Prof. Boyd Dawkins says that they established beyond all doubt the existence of paleolithic man in the Pleistocene age, and caused the whole of the scientific world to awake to the fact of the vast antiquity of the human race. Of course, they aroused a theological controversy which was long and bitter, and has only recently died out. Pengelly had no trouble through it all. "Geologists," he said, "see no mode of reconciling the Mosaic account of creation with geological science.... For myself, I am satisfied that science can do nothing for the salvation of the soul, and that the Bible is able, through God's grace, to make us wise unto salvation." No doubts or difficulties could ever undermine his faith as a Christian.

The evidence accumulated at Brixham suggested the propriety of a re-examination of other evidences of man's antiquity, and particularly, in England, of those from Kent's Hole, or Cavern, at Torquay. The existence of this cave had been known from time immemorial, but the first recorded exploration of it was made in 1824 by Mr. Northmore, of Cleve, looking for organic remains and an ancient temple of Mithras. Mr. W. C. Trevelyan followed him, and first obtained results of value to science. The Rev. J. MacEnery, a Roman Catholic priest, began a four years' [Pg 119] exploration of the cave in 1825, and prepared a narrative of his work, which was not published for several years after his death, having been lost, and found by Pengelly after a long search. He showed that the cave had been inhabited, practically at the same time, by man and various extinct animals; but the antiquity of man not being yet a live subject, little regard was paid to his evidences. With a grant of a hundred pounds from the British Association, the work was begun under the direction of a committee of which Pengelly was the leading spirit and the working member. It opened a new chapter in his life, his daughter says, "for he not only superintended the exploration of the cavern, but undertook its entire management, throwing himself, heart and soul, into the numerous duties which it entailed. The labor was arduous, and severely taxed his energies for fifteen years; but it was a congenial employment, and most faithfully performed.... After undertaking the exploration, Pengelly became such an enthusiast in the progress made that, when in Torquay, he never (unless prevented by illness) failed on a single week day to visit the cavern, while he devoted many hours at home in the examination of the specimens exhumed. He even abridged his short holidays, and all idea of living in London was abandoned on this account." In the investigation, the surface accumulations having been removed and preserved for examination, the floor of granular stalagmite was stripped off, so as to lay bare the cave earth, and this was dug out ultimately to a depth of four feet in a series of prismatic blocks, a yard long and a foot square in section, layer by layer. This material was examined in the cave by candlelight, then at the door by daylight. A box was appropriated to each "yard," in which all the objects of interest found in that particular earth were put. The boxes, with the record of what they contained, were sent daily to Pengelly, who cleaned the articles and repacked them, and kept regular records of his day's works. Other materials were dealt with with similar thoroughness in ways according to their nature. "Whatever was discovered beneath the stalagmite flooring must have been sealed up by it for, at the very least, two thousand years, probably for a much longer time." The exploration was completed June 19, 1880. The more than seventy-three hundred prisms of material which proved productive yielded, besides fifty thousand bones examined by Prof. Boyd Dawkins, numerous implements, including those of bone, the work of man. Two deposits were evident, one of "cave earth," and one of breccia beneath it. A glance at the implements from them showed that they were very dissimilar. Those from the breccia were more massive and ruder in every way than the others, and none of them were of bone. "In short, the stone tools, though both sets were unpolished and coeval with extinct mammals, represent [Pg 120] two distinct civilizations. It is equally clear that the ruder men were the more ancient, for their tools were lodged in a deposit which, whenever the two occurred in the same vertical section, was invariably the undermost." Various conditions in the deposits united in indicating that the interval between them must have been very considerable. Other caves were examined by Pengelly, but his most important discoveries were made in those of Brixham and Kent.

A third section of Pengelly's scientific work reviewed by Prof. T. G. Bonney in the summary he has added to Miss Pengelly's biography, from which we have quoted freely, includes miscellaneous papers on geology and kindred subjects, relating almost exclusively to the southwest of England. As a rule, the papers are comparatively short, being the fruits of researches which either did not demand a long time, or could be carried on at intervals as circumstances allowed, and appeared mostly in the transactions of local societies.

Pengelly was one of the prime movers and a leading spirit in the organization, in 1862, of the Devonshire Association for the Advancement of Science, Literature, and Art, at Plymouth, and was its president in 1867-'68. The objects of the association were "to give a stronger impulse and a more systematic direction to scientific inquiry in Devonshire, and to promote the intercourse of those who cultivate science, literature, or art in different parts of the country." It worked according to the methods of the British Association, with literature and art added to its objects, besides giving some attention to history and archæology. The first meeting was held under the presidency of Sir John Bowring. In 1872 the president was the bishop of the diocese, Dr. Temple, now Archbishop of Canterbury. In 1863 Pengelly was elected a Fellow of the Royal Society.

From 1856, when he read a paper at the Cheltenham meeting, Mr. Pengelly was almost a constant attendant upon the meetings of the British Association, and gained, as the years

advanced, a prominent position among its leading members. He was president of the Geological Section at the Plymouth meeting, 1877. At the jubilee meeting of the association, held at York in 1880, he made the acquaintance of Prof. Asa Gray, which ripened into a friendship and resulted in a visit of Professor Gray and Mrs. Gray to Torquay. He met another distinguished American man of science, Prof. O. C. Marsh, recently deceased, at the International Geological Congress in London, in 1888. In 1801 he received a visit from Prof. G. F. Wright. He opposed the transference of the meeting of the British Association to Montreal in 1884, on account of the expense and the sacrifice of time which he thought many who would like to attend could not afford, and did not go himself. In March, 1874, he was visited at Torquay by Professor Phillips and others in behalf of a [Pg 121] number of members of the British Association, and presented with an illuminated parchment containing the signatures of the contributors and a check, as a testimonial "in recognition of his long and valued services to science in general, and more especially for the exploration of Kent's Cavern. Replying to the addresses, he said he had done the work in connection with Kent's Cavern simply because he liked it.... He had experienced intense pleasure in it, and he could assure them that, on his finding a *Machairodus latidus*, after seven years and a half exploration, the discovery of that one tooth, in his opinion, was worth all the money that had been spent in the exploration of the cavern."

Besides geology, Mr. Pengelly had a living concern with astronomy, on subjects of which he lectured and read papers, and in folklore, and was "extremely interested" in the religious history of Cornwall. He became a member of the Society of Friends about 1853, and married his second wife, Lydia Spriggs, in that body. She assisted him in his scientific work, preparing diagrams.

Of Pengelly's character as a man, Professor Bonney speaks of the great charm in his personality, and the union in him of "such strong mental powers, and no less strong sense of what was just, true, and right, to such genuine humor and hearty enjoyment of wit." Sir Archibald Geikie speaks of his "genial, kindly, and helpful nature, and his invariably bright, cheery, and witty talk." Prof. Rupert Jones characterizes him as "a good example of a religious man—earnest, persevering, and exact in scientific research." The Rev. Robert Hardy says, "He did not obtrude his theological opinions, but it was easy to perceive that he was a man of true religious character." Sir Joseph Lister, looking back to the times of his acquaintance with him, recalled "vividly the impression of his great intellectual powers, his genial benevolence, and his sparkling humor."

As a lecturer his style is described as having been "most attractive. It is incisive, clear, and at times there are touches of humor. His perfect knowledge of the subject, combined with intense earnestness, clothed his lecture with genuine eloquence."

Miss Pengelly's biography abounds with illustrations of her father's rare faculty of attracting and interesting workingmen. A letter from one such man expresses gratitude, mingled with great pleasure, for the lasting happiness he was "so anxious and constant to impart to us young men during the Young Men's Society and afterward at the Mechanics' Institute, ... and I have often felt and said I owe more gratitude for the small amount of knowledge I possess, to Mr. Pengelly, of Torquay, than to any living man, and I think there are a few now in Torquay who might truly say so too."

Editor's Table.

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KINDERGARTENIZED CHILDREN.

We do not know whether the verb "to kindergartenize" has yet crept into the language, but, after reading the article of Miss Marion Hamilton Carter in the March Atlantic on The Kindergarten Child—after the kindergarten, one is disposed to think that such a verb is a present necessity. The question as to whether the kindergarten on the whole is a good institution is too wide for discussion within the restricted limits of the Table; but no one can read Miss Carter's article without being forced to the conclusion that, in some of its aspects, kindergarten work is of very doubtful utility. That lady found by actual experience with two or three successive levies of kindergarten children that they seemed to have an impaired rather than an improved faculty of acquiring knowledge, that their infancy seemed to have been artificially prolonged, that they had become accustomed to a nauseating amount of endearment in the language addressed to them by their instructors, that they seemed to expect to be continually amused, and that a certain drill through which they had been put for the alleged purpose of developing their powers of imagination had gone a long way toward making them incapable of speaking of things simply as they found them. All this is set forth in Miss Carter's article in a manner which leaves little doubt that she has described things substantially as they fell under her observation.

There is one important principle in education which it seems to us the kindergarten system too much ignores, if it does not completely set it at defiance, and that is that very young children require a great deal of letting alone. The spontaneous activity of the little ones—and they are sure to be active if they get the chance—is worth more for their education than any amount of directed activity. Their imaginations, too, will take care of themselves much better than we can take care of them. Nothing is less favorable to the development of imagination in a child than constant intercourse with grown people who have passed the imaginative stage, and whose daily duty it is to lay out ordered knowledge for assimilation by these babes. It is no wonder that part

of the system should consist of special exercises for the cultivation of the very faculty which the system as a whole is so adapted to dull and to weaken. Anything much more silly, however, than the method described by Miss Carter it would be difficult to imagine.

The great popularity of the kindergarten is due in large measure to the fact that it relieves mothers during part of the day of the care of their small children. That it does this in very many cases at the expense of weakening the tie between mother and child there is too much reason to fear. The State has been stepping in more and more between parents and children, until now it lays its hand almost upon the cradle. The mothers of the republic are giving way, so far as influence over the rising generation is concerned, to the schoolmarms; but it is idle to expect that the latter can take the place of the mothers we used to know. The kindergarten constitutes a vast extension of the educational machinery previously in operation, and machinery is always impressive, especially to those who do not understand it. What people see is that the system [Pg 123] works very smoothly and uniformly and rhythmically, and that it saves, or seems to save, them a great deal of trouble; and that it is enough to make them think it something very fine. Whether it is really saving trouble in the end is a question which we consider quite open to discussion. There is room, in our opinion, to inquire whether the stimulus of society is not too early and too systematically brought to bear on the infants who throng the educational nursery—whether it is well for children of three and four to be brought every day under the eye of, and more or less into competition with, a large number of companions of their own age. We doubt much whether it tends to simplicity of character, and we can not but regard it as distinctly unfavorable to the development of individuality. The rule of fashion begins at once to operate with great intensity, and the child loses the power of conceiving life except in the herd. As to whether trouble on the whole is being saved to parents by the new system, the question could best be answered by ascertaining whether, in the long run, parents have more or less trouble with their children now than formerly. We should be surprised to hear any one maintaining that they had less.

We are aware that parents, for the most part, enthusiastically testify that their children enjoy the kindergarten very much; but may it not be possible for children, as well as their elders, to like what is not altogether for their good? We do not consider that we can safely follow all a child's likes and dislikes in the matter of diet, or companionship, or hours for going to bed and rising. Sensible people do not think that everything children crave should be given to them, or that more than a limited number of excitements should be thrown in their way. It is one of the drawbacks to wealth that the possessors of it can hardly refrain from half burying their children beneath a profusion of toys, and crowding upon them such a multitude of distractions, in the way of travel, shows of all kinds, and society, that all chance of development from within is well-nigh destroyed. It has been remarked by many that the children of to-day who rarely read a story that is not illustrated, have much less imagination than the children of former days, who in reading had to make and did make their own mental pictures. Yet what pampered child ever said he or she was pampered too much? What overflattered child ever asked for a surcease of flattery? What child suffering from an excessive amount of social excitement ever requested that it might have less of such unhealthy stimulation? The inference we draw is that it does not settle the question finally in favor of the kindergarten to say that children enjoy it. If Miss Carter's experience is to be depended on, the result at least of some kindergarten training is to stimulate the vanity of the little ones and give them a quite undue sense of their self-importance. They would enjoy that while it lasted, poor little things! but it would be a bad preparation for the subsequent work of education. One broad fact stares the educational world in the face, and that is that the average child has to-day, at a given age, a less capacity for learning than the average child of twenty-five or thirty years ago. What share the kindergarten may have had in this retardment of intellectual development is a question which deserves investigation. Messrs. McLellan and Dewey, in their work on The Psychology of Number (International Education Series), say (page 154): "We have known the seven-year-old 'head boy' of a kindergarten, conducted by a noted kindergarten [Pg 124] teacher, who could not recognize a quantity of three things without counting them by ones.... There is surely something lacking either in the kindergarten as a preparation for the primary school, or in the primary school as a continuation of the kindergarten, when a child, after full training in the kindergarten, together with two years' work in the primary school, is considered able to undertake nothing (in arithmetic) beyond the number twenty." These authors enter into a very elaborate analysis of the number concept, and lay down with extreme care what they conceive to be the best lines of approach to the youthful mind in the teaching of arithmetic. It seems to us, however, that the number concept will dawn upon the youthful mind without much effort on the part of teachers when the time arrives for it to be of use. In most childish games the element of number is involved. The smallest girl with a skipping rope will get into the way of counting her skips with a more or less distinct conception of the difference between one number and another. So in the matter of "turns" in any game in which two or more are engaged: if one child wants to have more "turns" than it is entitled to, the others have to be very young indeed not to protest. In a tug-of-war with, say, four on each side, the addition of a fifth to one side without permission would make trouble in the camp. When candies are being distributed the arithmetical sense is generally keenly alive.

We conclude by commending Miss Carter's article to the careful consideration of all who are interested in educational problems. She writes with a certain tinge of vexation, and, without meaning it, may have somewhat forced the case against her kindergarten children. The Atlantic Monthly deserves credit, we must add, for the many able and timely articles which it has lately been publishing on educational topics—articles stamped by the breadth of thought and high culture which are characteristic of our contemporary, and eminently adapted to assist in delivering our educational methods from bondage to a mechanical routine, and bringing them

nearer to the simplicity and freedom of Nature.

IS FREEDOM LIMITED BY CLIMATE?

Since the United States turned its ambition toward the tropics, the question as to whether its political institutions can be extended to the inhabitants there has been widely discussed. As might be expected, the philanthropic advocates of expansion have insisted that "the blessings of freedom and civilization" are not limited by latitude or longitude. Any other position would, of course, have involved them in the charge of inconsistency and hypocrisy. But certain philosophic expansionists, as they may be politely called, have taken the opposite view. "It is a cardinal fact," they say, quoting the language of a recent essay of Mr. Benjamin Kidd, "that in the tropics the white man lives and works only as a diver lives and works under water.... Neither physically, morally, nor politically can he be acclimatized in the tropics." Still quoting his language, they say again that "a clearer insight into the laws that have shaped the course of human evolution must bring us to see that the process which has gradually developed the energy, enterprise, and social efficiency of the race northward, and which has left less richly endowed in this respect the people inhabiting the regions where the conditions of life are easiest, is no passing accident, nor the result of circumstances changeable at will, but part of the cosmic order of things which we have [Pg 125] no power to alter."

Whether Mr. Kidd recognizes the odious significance of his captivating speculation or not, it is certainly a plea and an apology for slavery and political despotism in the tropics. Most welcome will it be to all those nations and people of easy conscience and measureless greed that now hold in bondage of greater or less intensity millions of the inhabitants of that rich and splendid region. But there is reason to believe that it must be relegated to the limbo of a kindred and popular superstition. Within the past year much has been said about the genius of the Anglo-Saxon for freedom and the ethnic incapacity of the Latins for that boon of civilization. Even so great a scholar as Guizot encourages this extraordinary theory. Again and again does he point out in his History of Civilization how the spirit of freedom may be traced to the Teutonic hordes that swarmed the forests of Germany. He does so despite the overwhelming evidence against him to be found in his own pages even. In apology for his misinterpretation of social phenomena there can be urged his ignorance of the law of evolution and of the hardly less important law of the militant origin of despotism and the pacific origin of freedom. No such apology can, however, be made in behalf of Mr. Kidd, or of any other apostle of imperialism. Not only have they at command all the generalizations of social science, but all the facts upon which those generalizations are based, to prove that neither climate nor race is a limitation upon freedom.

If climate determined the character of the political institutions of a people, many questions would be suggested at once that would be beyond solution. Why, for instance, should a certain freedom have existed in Athens, and the most intolerable despotism in Sparta? Again, why should there be despotism in Russia and Germany as well as in Morocco and Egypt? Another series of questions equally perplexing can be raised. Why should there be more freedom in England to-day than six hundred or even one hundred years ago? The climate has not changed in the interval. Why should the institutions of Spain in the thirteenth century have been more liberal than in the seventeenth? Why was it that the freedom that existed in Germany before the Thirty Years' War had virtually ceased to exist at the Peace of Westphalia? Here also the climate had not changed. Why, finally, was there a reaction toward despotism in France after the French Revolution, in Germany after the disturbances of 1848, in England after the Crimean War, and in the United States after the rebellion? The only satisfactory answer to these questions is to be found in the fact that militant activities always lead to despotism, and pacific activities always to freedom. When people get into war, the central power must exercise all the authority over life and property essential to success in battle. The impulse thus given to despotism spreads to every part of the social fabric. When people are devoted to the pursuits of peace, the forces that make for freedom transform their ideas, feelings, morals, and institutions, political, industrial, and social.

Whether despotism exists, as Mr. Kidd and his followers assume, among all the indigenous populations of the tropics, only a careful investigation of the subject would permit one to say. But that it must, as they contend, always exist there, none of the laws of social evolution gives the slightest warrant. Wherever it does exist, it had the same origin that it had in England, and in obedience to the same forces of peace and industry that operated against it in that country, it must pass away. The struggles between clans and tribes for the possession of desirable territory, [Pg 126] or for the capture of food or slaves, or for the gratification of predatory and belligerent instincts, gave rise to the permanent chief, to the ruling hierarchy, and to all the other characteristics of a militant society. The degree of heat or humidity or the luxuriant vegetation of the tropics had no more to do with this political organization than the degree of cold, or the dryness of the atmosphere, or the comparative poverty of the soil of some of the Western States with the similar political organization of the Indians that roamed over them. None of these physical characteristics can prevent the play of those forces that drive people eventually to the adoption of that form of social organization that will best promote their happiness. As the social philosophy of evolution shows, the social organization best fitted for this purpose is the one where the largest individual freedom prevails. Since the abolition of slavery and serfdom and many other forms of despotism has been found necessary for the best interests of society in Europe, we have a right to believe that the abolition of the same forms of despotism will be found necessary for the best interests of society in the tropics.

It is true that in the tropics the white man has found it uncomfortable to work, and has often

reduced the indigenes to a kind of slavery. But that either is inevitable and unavoidable because of the laws of social evolution, or any more than a temporary reversion, there is no reason for holding. Alfred Russel Wallace, who spent twelve years in the tropics, says in a recent article that the white man can and does work in every part of them. If he does not work, it is simply for the same reason that he does not work in Europe or the United States—namely, because he does not have to. When, however, necessity lays its heavy hands on him, driving him to earn his living by the sweat of his brow, he does it in the tropical region quite as well as he does in the temperate. That is shown particularly in Queensland. But when natives can be reduced to slavery the crime is committed with slight compunction, and defended on the same ground that it was defended in the South and elsewhere. The time must come, however, as it came in Brazil and in other countries where slave labor was found too wasteful and demoralizing, when it will be displaced with free labor. The time must come, too, when free institutions will be found as essential under the equator as farther north. Without them social evolution can not reach its highest point, nor man attain to his greatest happiness, a state that he is always seeking, no matter where he lives.

Scientific Literature.

SPECIAL BOOKS.

The famous discovery in Java, by Dubois, of the skullcap, femur, and two teeth in the upper Tertiary rocks has led to many interesting discussions, among which was a paper read by Ernst Haeckel before the International Congress of Zoölogists, held in Cambridge, England, last year. In this paper Haeckel contended that in these remains we had at last the long-sought-for missing link.[41] This paper excited much interest, which led to a request for its publication. The [Pg 127] intelligent public, without knowing much about the value of the osteological points under discussion, were ready to grant that here indeed was the missing link, since the highest authorities in science were divided in opinion as to whether the remains belonged to a very low member of the human race or a very high member of the manlike apes. The conclusion would naturally follow that it made but little difference whether the remains proved to be those of man or monkey, as here was a creature so intermediate in structure that it stood on the dividing line, so to speak. In this little book Haeckel presents the old evidences as to the structural similarities between man and the higher apes, and places the Java remains (*Pithicanthropus erectus*) as the last link in the chain of descent. He also traces the ancestors of the apes through the mammalian series down, step by step, to the lowest vertebrates, and on through the invertebrates to the lowest forms of life. The suggestions are in many cases hypothetical yet instructive, as showing the possible lines of descent.

The unaccountable attitude of the distinguished Virchow in the presence of these remains is in harmony with his uncompromising and, one might say, unreasoning attitude in regard to the derivative theory. Haeckel shows this up very clearly in the following, which we quote: "Virchow went to the Leyden Congress with the set purpose of disproving that the bones found by Dubois belonged to a creature which linked together apes and man. First, he maintained that the skull was that of an ape, while the thigh belonged to man. This insinuation was at once refuted by the expert paleontologists, who declared that without the slightest doubt the bones belonged to one and the same individual. Next, Virchow explained that certain exostoses or growths observable on the thigh proved its human nature, since only under careful treatment the patient could have healed the original injury. Thereupon Professor Marsh, the celebrated paleontologist, exhibited a number of thigh bones of wild monkeys which showed similar exostoses, and had healed without hospital treatment. As a last argument the Berlin pathologist declared that the deep constriction behind the upper margin of the orbits proved that the skull was that of an ape, as such never occurred in man. It so happened that a few weeks later Professor Nehring, of Berlin, demonstrated exactly the same formation on a human prehistoric skull received by him from Santos, in Brazil."

Mr. *Russell* expresses a hope that the review of some of the characteristics of rivers given in one of the chapters of his *Rivers of North America*[42] may stimulate a desire in American students "to know more of the many and varied charms of their native land." The study of rivers is an alluring one, whether pursued upon the little local stream of one's neighborhood or upon the grand rivers that form systems and determine geographical districts; whether made with the assistance of a fishing-rod or of a steamboat. It can not fail to be promoted by Mr. Russell's instructive book, which the local student or the excursionist may consult with profit, while the geographer and geologist will find it a convenient manual. A river, when we come to think of it, means a great deal. Economically, it is the most valuable topographical feature a country can possess; geologically and geographically, it is a result of prominent features of the earth's structure, and is the cause of modifications in its surface which in time may revolutionize the topographical [Pg 128] conditions and produce climatic and physical changes. All these characteristics of rivers are systematically and comprehensively set forth in Mr. Russell's book, where the life-history of the stream is presented, from its beginning in a little mountain torrent or hillside rill, through its course as it descends to the plain, wearing and tearing and deepening its channel. In the plain its

character and action are modified under the new conditions in which it finds itself, and gradually, as it approaches its mouth, it deposits, whereas it had torn away at its beginning, and shows contrasts quite as marked as those between youth and old age. Rivers have their growth in time, too, and a stream that has been carrying on its work for long ages presents different characteristics throughout its course from one that comes fresh to its task, and these differences are pointed out. We are told, too, how rivers grow, drawing new affluents to themselves and extending their sources backward, and how when the sources of streams on different sides of a watershed approach on the summit, there is a struggle for the mastery. These are only a few of the new suggestions which the book offers us. Coming to the more matter-of-fact details, the laws governing streams and their course; the influence of inequalities and the hardness of rocks, especially on riverside scenery; and the office of rivers as carriers of material in suspension and in solution, are considered; then their deposits, under various heads and aspects, and the effects of changes in the elevation of the land, of variations in the load of material and of changes of climate upon them; the origin and characteristics of stream terraces and stream development, the topics concerning which are too many and varied to bear more than a passing reference. The more salient characteristics of American rivers are discussed as to the nine drainage slopes—the Atlantic, St. Lawrence, Hudson Bay, Arctic, Bering, Pacific, Great Basin, Gulf, and Caribbean—each slope presenting its own general characteristics, with varieties in detail almost as numerous as the rivers. The whole is briefly summarized in the last chapter, The Life History of a River. We have given merely the tamest inventory of only a part of the topics of Mr. Russell's book. As the subject is treated by the author with careful attention to specific features, as the magnitude of our river systems is indicated, and as rivers with different or contrasting characteristics—the St. Lawrence and the Colorado, for example—are compared with one another, the subject takes on an aspect that is really grand.

GENERAL NOTICES.

An unfulfilled intention entertained by two successive prosectors of the London Zoölogical Society—the late Professor Garrod and the late W. A. Forbes—of writing a treatise on bird anatomy, is carried out in the present work[43] by their successor, *Frank E. Beddard*. Professor Garrod had nearly completed an account of the Anatomy of the Fowl, which was to be followed by a presentation of the anatomical characters of the different groups. Professor Forbes died before he was able to add anything to the manuscripts left by Professor Garrod. In the instance of the present work the detailed account of *Gallus*, with which Professor Garrod intended to preface his book, has been rendered unnecessary by Dr. Shufeldt's monograph on the Raven, dealing with one particular bird type. Accepting this as a sufficient presentation of that feature of the subject, Mr. Beddard begins with a general sketch of bird structure, purposely avoiding histological detail and the elaborate description of anatomical facts, which in the present state of our knowledge [Pg 129] are not of great use in classification. The main part of the book is the account of the structure of the different groups of birds, which is treated of to a considerable extent; and a large number of facts, some of which are recorded for the first time, are incorporated in the systematic part of the book. While all the principal facts pertaining to the subject are believed to have been given, and nothing of importance to have been left out, references are made in each section to most of the memoirs already published. The majority of the facts of bird structure have been verified by the author, especially those relating to osteology and anatomy, and he has drawn liberally on the notebooks of his two predecessors. The book gives first an account of the general structure of birds; next of the reproductive and renal organs, the circulatory, respiratory, and muscular systems, osteology, brain and nervous system, and affinities of birds, and, finally, the classification.

Bush Fruits[44] is the first of a proposed series of monographs on the various types of American fruits, to be published under the editorial direction of Prof. L. H. Bailey. Its purpose is to present both the practical and the technical phases of all the important questions concerned in the cultivation and domestication of the fruits that grow on bushes; and the attempt is made to present these two sides separate from the details of history, botany, and entomology, so that the practical reader may be introduced at once to the information he is seeking. The aim is made to treat general truths and principles rather than mere details of practice, leaving the reader to think out and solve the local problems for himself. The author, Mr. *F. W. Card*, who presented the work originally as a Cornell University thesis, was first a bush-grower, and then a student and teacher, acquiring first the practice and then the theory. The fruits treated of are raspberries, blackberries, dewberries, currants, gooseberries, buffalo berry, gounie, huckleberries, Juneberries, the cranberry, barberry, and sand cherry—all, as to their important types, except the currants, evolutions from the species of our own woods. A useful list of American books on bush fruits is given in the appendix.

The History of the World, from the Earliest Historical Time to the Year 1898,[45] is the latest addition to the Concise Knowledge Library, "a series of volumes on great subjects, containing in an abridged form a wealth of exact information which can be thoroughly relied upon by the student, and yet of such a popular character as to meet the needs of the general reader." This compact volume of 790 pages presents a complete survey of the world's history. After a brief introduction describing the various races that have furthered civilization, ancient history proper begins with the Egyptians, the people of whom we possess the earliest records, and who were the first to emerge out of the darkness of prehistoric times. Closely connected with them, both by racial affinities and political ties, were the other great empires in the southwestern part of Asia

that one after the other rose, flourished, and fell into decay. The interesting part of the book here is the constant reference to the familiar facts of the Bible, the connection of the known with the unknown. The rise and development of Greece and Rome, following in due course, bring us down to the middle ages. Mediæval history has for its stage Europe, and for its argument the upbuilding of the states on which our modern political institutions rest. Modern history, dating from the discovery of America, then turns the eyes of the nations westward, to found empires beyond the sea. Nor is the East forgotten. Asia, the cradle of man, and Africa, where he first rose into consciousness of himself and recorded his deeds, again claim the historian's attention. But now it is China and Japan on the one continent, and the conquests and colonies of the Europeans on the other. Neither is the country youngest in civilization, Australasia, passed by. And the [Pg 130] history of all these countries, whether east or west, is brought down to date. Even our recent war with Spain is briefly told. Indeed, the value of the book as a work of reference lies in the fact that it encompasses *all* the world's history, giving in compact, handy form the chief data in the progress of the human race, that otherwise must be sought for in a dozen different places. Another valuable feature of the book, attainable only on the plan of rigid selection of salient points, is the connection between the different peoples. Their interdependence, the sequence of their appearance on the stage of action, and their decline, are most vividly realized in such a bird's-eye view. The book has maps and a full index.

The essays comprised in Mr. *William M. Bryant's* volume entitled *Life, Death, and Immortality, and Kindred Essays*[46] have developed, as he expresses it, one by one during a number of years past. The term developed is a happy one, for the papers were certainly not made to order, but read like results of systematic, continuous thinking. They concern the religious aspect of human nature. The author thinks that negative criticism has for the time being exhausted its resources, and the time has come for further positive interpretation of the fundamental conceptions of the Christian doctrine as to man's nature and destiny. A reference to a few of the points in the first essay, which gives the title to the book, will afford a view of the author's method. Men of science are constantly insisting that the total quantity of energy is changeless, and nothing can be added to it and nothing taken away. What are the "total quantity of energy" and the "great first cause" but the same, to the activity of which is due every phase of reality? This being changeless, it could not at some period "have created a world and afterward left it to spin on of its own accord 'without interference.'" Mind is a form of energy, consequently indestructible and undying, and the question of immortality is reduced to the form "whether in respect of man's essential nature as a thinking unit, death can ever be more than transition from one to another grade of life." Other essays are on Oriental Religions, Church Organization, The Heresy of Non-Progressive Orthodoxy, Christian Ethics and those of other religions, and Eternity.

Professor *Merriman's Elements of Sanitary Engineering*[47] is a thoroughly practical treatise setting forth the principal rules and laws relating to sanitation, both individual and municipal, as it is practiced to-day. A brief historical introduction is followed by a classification of diseases, and a general consideration of such questions as filth and disease, impure air and disease, drinking water and disease, etc. The second chapter takes up the question of the purification of water. Chapter III discusses the practical aspects, for a municipality, of water-supply systems. Consumption of water, capacity of storage reservoirs, pipe lines, pumping engines, tanks and stand pipes and street mains are among the special headings. Sewerage systems are next dealt with. A discussion of questions connected with the disposal of garbage and sewage forms the fifth and last chapter of the book. An item which adds value to the volume is the series of exercises and problems, practically applying the laws set forth, which follows each chapter.

An Epitome of Human Histology[48] has been written by Mr. *Weysse* to meet the difficulty in which the conscientious student of microscopic anatomy is placed who finds himself in possession of a great many isolated facts about the minute structure of the body, but with rather an indefinite conception of the relation of those facts to one another and of the subject as a whole. In the writing the author has sought to present all the facts that are of real importance to the student; to express them in the briefest and clearest language, omitting whatever is not strictly required; and to arrange them in such a way that the reader, in considering any organ, may, if he [Pg 131] will, actually sketch each part as he proceeds, and thus make a diagrammatic plan or picture of the entire structure. The book is not for idle students, but for serious ones, and it is not a text-book or intended to take the place of one; and it can serve its true purpose only when used by students who have had laboratory practice as well as lectures in histology, and have thus examined the actual structures.

In his work on *Elementary Botany*,[49] Professor *Atkinson* introduces the method which he has found successful in teaching beginners. Many of the newer botanical text-books, in reacting against the plan of presenting first the higher types of plant life, overwhelm the student not only with a multitude of unfamiliar forms, but demand from him powers of comparison and analysis that are generally the result of much scientific discipline. In this book the pupil receives some preliminary guidance in habits of correct induction. By studying the processes of transpiration, nutrition, growth, and irritability in plants belonging to higher as well as lower groups, he learns the universality of these life principles, and is led to see the foundations for sound generalization. This the author considers vastly more important than the knowledge of individual plants. The student, however, in this investigation becomes acquainted with special forms among the lower plants, and is thus prepared to take up morphology systematically. This topic begins with the study of Spirogyra, and ends with an outline of twenty lessons in the angiosperms. The final third of the book is devoted to ecology, the study of plants in their natural surroundings and of their

modifying factors—climate, soil, topography, etc. The illustrations, which are above the average throughout the work, are in this division exceedingly good. The descriptive text of the same section is entertaining enough to be used as a class reader, and would interest those unfamiliar with botany. There are several slight errors to be corrected in a future edition. In the table of measures a kilometre is made to equal one hundred instead of one thousand metres, and the references to plates are occasionally wrong. On page 345 the reference should be 449, and on page 349 should be 458 in place of 457. In describing pollination of the skunk cabbage, the words "rub off" are ambiguous. The uninitiated might suppose that the insect obtained pollen from the stigmas instead of depositing it there. The book is not intended for recitation, but for reference and as a guide in study. It is supplied with an appendix upon the collection and preservation of material, and an index.

A notice of a book[50] of this nature is justified in this column, since it contains much that will be of interest to the student of ethnology, folklore, and cognate subjects. It is interesting to get a glimpse of matters pertaining to social customs, ways of thinking, and the occurrences which animated these ways among the Japanese a thousand and more years ago. The author says, "It is a remarkable and, I believe, an unexampled fact that a very large and important part of the best literature which Japan has produced was written by women."

The preparation of his *Elementary Text-Book of Botany*[51] was undertaken by Mr. *Vines* to meet a demand which appeared to exist for a less bulky and expensive volume than his Students' Text-Book. A more important feature than the diminution of the bulk is claimed in the simplification which the contents have undergone from the omission of certain difficult and still debatable topics. The usual divisions into morphology, anatomy, physiology, and systematic botany are followed; but the caution is appended that it must not be forgotten that these are all parts of one subject, different methods of studying one object—the plant. Hence they must be pursued together. "For instance, the morphology of the leaf can not be profitably studied without a [Pg 132] knowledge of its structure and functions; and it is also important to know what is the systematic position of each of the various plants whose leaves afford the material for study. In a word, the student should not attempt to read the book straight through from the beginning as if it were a novel. On the contrary, he may begin with any one of the four parts as his main subject; but that part must be studied in close relation with the other three parts"; and this method of proceeding is facilitated by the insertion of a large number of cross-references in the text.

A satisfactory account is given by *C. Francis Jenkins* in *Animated Pictures*[52] of the development and present state of chronophotography, or the art of "conveying by persistence of vision a counterfeit impression of objects in motion through the display in rapid succession of a series of related pictures." The story shows very clearly that this, like most other inventions of consequence, is no sudden discovery, but is the culmination of a very long series of experiments. The principle of it is embodied in the toy, the zoetrope, the origin of which is not known, though a citation from Lucretius indicates that something of the kind existed in his time. With the discovery of instantaneous photography, a new application of the principle of the zoetrope was found. Muybridge and Marey were pioneers in this development with their photographs of the motions of animals valuable in sciences. Since their work was begun the photographic processes and apparatus have been greatly improved. Mr. Jenkins forecasts a brilliant and useful future for the art, which he hopes will be prosecuted along the line of other than its present most popular uses. The book is practical as well as historical and prophetic, and contains an account of Mr. Jenkins's phantoscope as the first successful "moving picture projecting apparatus," for which he received the Elliott Cresson medal from the Franklin Institute.

The Metric System of Weights and Measures, prepared by Mr. *A. D. Risteen*, and published by the Hartford Steam-Boiler Inspection Company, Hartford, Connecticut (price, $1.25), gives what has long been wanted—a neat volume, convenient for the pocket and durably bound, furnishing tables for instantly converting all the metrical units up to one hundred of each into those of the English weights and measures, and *vice versa*. Calculation, being needed only for the numbers above one hundred, for which there are already short devices, is reduced to the lowest possible limit.

Terrestrial Magnetism, an international quarterly journal, edited by *L. A. Bauer* and *Thomas French, Jr.*, and published at the University of Cincinnati, is the recognized organ of the International Conference on Terrestrial Magnetism and Atmospheric Electricity. The September number, 1898, contains the proceedings of the conference, which met in connection with the last Bristol meeting of the British Association. It contains in full the welcoming address of Prof. W. E. Ayrton, the opening address of A. W. Rücker, president of the conference, and ten of the papers read at the meeting.

The name of Prof. *John Trowbridge* as author of such a book as *Philip's Experiments; or, Physical Science at Home* (D. Appleton and Company, $1) is a sure guarantee of its scientific value. The author has given a chapter substantially out of his own experience, for he says his taste for science and for drawing were stimulated by his father in the manner here described. His object in publishing it is "to show that a few moments devoted each day at home to simple investigations can result in habits of self-reliance in the acquirement of a modern language and in the study of the art of drawing." He endeavors also to show how to cultivate a taste for mathematics by studying practical problems in surveying and in sailing a boat; and how much a parent can accomplish in the formation of a son's tastes without special knowledge, and without the expenditure of much time and money. The account is in the form of letters from the father to a [Pg 133]

friend, describing his experiments with his son Philip in this method of teaching. He has always cultivated fellowship with the boy; and, finding him inclined to improve and add to the designs on the wall-paper, puts objects to be drawn and copied in his way, and induces him to go out and draw from Nature. So the boy learns to study forms and observe. To teach language he gives him regularly the daily German newspaper, to pick out what he can from it, and joins him in the sport. In a similar way he introduces Philip to surveying and physics, and other branches of science. The plan is a success; Philip attracts attention by the ingenuity which his training has enabled him to develop, and going to college is graduated with credit and in possession of a live as well as a book knowledge of what he has studied.

In *The Story of the English* (American Book Company) the more prominent facts of English history from the beginning to the present time are related by *H. A. Guerber* in simple, brief narratives. A commendable feature of the book is the insistence in the preface of the essential oneness of the English and American people—an idea that can hardly be too sedulously cultivated. The author's principal object has been to render pupils so familiar with the prominent characters of English history that they shall henceforth seem like old acquaintances, and, in addition, to make the story attractive; but it is a fact to be regretted that he has regarded the growth of English law and liberty and the changes in religion as too unintelligible and uninteresting to be more than touched upon "very briefly and in the most simple way." The growth of law and liberty are the very things that it is most important to fix the attention of children upon, and it is only because they have suffered comparative neglect in the education of teachers in favor of stories of war and intrigue that they are not the most intelligible and interesting branch of the subject.

Prof. *Francis E. Nipher*, of Washington University, having been called upon to present a paper to an educational convention on the Greater Efficiency of Science Instruction, undertook to show how such changes as were adapted to promote that end might be accomplished without radical departures from present methods; and the *Introduction to Graphical Algebra* (Henry Holt & Co., New York, 60 cents) is the result of that effort. The author believes that the study of algebra and geometry as distinct subjects having no relation to each other gives the pupil a false idea of the intellectual situation of to-day; that by injecting here and there into the ordinary instruction in algebra such material as is found in his book, new meaning will be given to the operations involved in the solution of equations, and new interest in the subject may be aroused; and that as scientific investigators are making much use of other methods than Euclid's, while the study of his geometry should not be banished from our schools, some of the time given to it might be usefully spent in elementary analytical geometry or graphical algebra. The treatise is brief and convenient in size and composed in clear language.

The New Man, a Chronicle of the Modern Time (Philadelphia: The Levytype Company), is a story written by *Ellis Paxson Oberholzer* with reference to that expansion of women's education and sphere of action which is suggested by the phrase "the new woman." In it "the new woman is developed to her logical conclusion, and the new man as he must needs become under the reaction of her influence," and it deals with "men and women imbued with the modern university spirit, whose emotional natures are developed under the scientific impulse of our time, and whose thoughts and actions reflect that impulse in the midst of all the varied realities of our modern life."

Armageddon (Rand, McNally & Co.), to the plot of which the author's name of *Stanley Waterloo* seems curiously appropriate, is possibly a specimen of a class of literature to which we are likely to be treated in abundance for a few years to come. The spoliation of the Spanish Egyptians by the Americans having come to a halt with the gain of Puerto Rico and the Philippines, the great [Pg 134] Anglo-American alliance enters upon the view and is made a fact, though informally. The two nations together build the Nicaragua Canal, and are about to celebrate its completion, when they are anticipated by the precipitation of the war of the nations through the simultaneous occurrence of a number of slight international quarrels in different parts of the world. Germany, Russia, the Scandinavians, and the Latins are pitted on one side, and the British and Americans, assisted by the British colonies and the Japanese, on the other; and the battle of the combined fleets occurs near the Canaries. The hero of the story has invented an air ship which carries terrible explosives to be dropped from a great height into the midst of the enemy. This engine does its work at the decisive moment, and then follows the grab game of negotiations, in which might rules, and Germany joins the Anglo-Saxon alliance against the rest of the world. Finally, the air-ship engine of destruction has rendered war henceforth forever impossible.

Mr. *James Reid Cole*, president of a classical and military school at Dallas, Texas, has published under the title of *Miscellany* what is substantially a picture or transcript of his own life. It contains a variety of articles—literary essays, school addresses, and even schoolboy compositions—the chief interest of which is to the author and his close friends. Other papers, such as A Bird's-eye View of Johnston's Surrender, the sketches of the Life of Lieutenant C. C. Cole, the Looking Backward over the course of the author's own life, and political and legislative speeches may have a more general value as partial reflections of the times to which they relate, more intimate than are usually to be derived from ordinary sketches and histories.

The publications of the *New York Academy of Sciences* now consist of two series—the *Annals* (8vo) and the *Memoirs* (4to). The Transactions, in which the shorter papers and business reports have hitherto appeared, are abolished, and the matter appears in the Annals. This publication, which was begun in 1824, contains the scientific contributions and reports of researches, together with the reports of meetings. The complete volumes will hereafter coincide with the

calendar year. Vol. X, Nos. 1 to 12, contains three papers by H. S. Davis and one by Frank Schesinger based on the Rutherfurd photographs of the stars; The Nature and Origin of Stipules, by A. A. Tyler, and an examination of the Ascidian Half-Embryo, by H. E. Crampton, Jr. Vol. XI, Part II, contains the annual address of retiring President J. J. Stevenson, February 28, 1898, on the Debt of the World to Pure Science, and six articles on special subjects in biology.

The Commissioner of Labor was authorized by Congress in 1895 to make an investigation, so far as it could be done within the limits of the regular appropriations to his department, relative to the economic aspects of the liquor traffic. He interpreted such an investigation to include the consideration of monetary conditions; of the agricultural and other products used in the production of liquors; of the manufacture of liquors as a distinct industry; of transportation, consumption, and the traffic in them; of the revenue derived from them and the laws regulating its collection; and of the experience and practice of employers in relation to the use of intoxicants. In some of these phases of the subject the facts were not separable from those relating to other matters; in others, they were to be found in the reports of other departments; and original inquiry was necessary only with reference to the last three items of the category. The results of this inquiry are given in the *Twelfth Annual Report of the Commissioner of Labor, 1897*, under the heading of *Economic Aspects of the Liquor Problem*.

A New Story of the Stars is an essay in which *A. W. Bickerton*, professor of chemistry and physics in Christ Church College, New Zealand, sets forth a theory of the origin of universes or of parts of universes by impact. Nebulæ already existing—but how existing we are not informed—careering through space, are supposed to collide, whereby heat and light are developed. They may meet in face, and would then probably coalesce, but more likely the impact would be a grazing one, when three bodies would be produced; a portion, or slice, as the author calls it, of each of the colliding bodies would be sheared off, forming an intensely hot and bright new star, while the original masses would go on their course, having the parts that had been in contact heated and made brilliant, so as to present in their revolutions the aspect of variable stars. The author's attention was drawn to this subject by the appearance of a new star in Cygnus in 1877. A little while afterward Nova Aurigæ appeared, presenting exactly the phenomena he had predicted. Professor Bickerton writes as one who understands his subject; there is nothing in his speculations, so far as we have observed, that grates harshly with known facts, and it can be read, as he reads it, to account plausibly for some of the facts—just as can several other theories of the formation of the universe which are still only speculations. The problem is yet far from comprehension, and is one of the legacies which the nineteenth century is destined to bequeath to the twentieth. (Published at Christ Church, New Zealand.)

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Fragments of Science.

Death of Professor Marsh.—Othniel C. Marsh, professor of paleontology in Yale University, and curator of the geological collection of that institution, died of pneumonia at his home in New Haven, Connecticut, March 18th. He had not been in good health for several years, and succumbed to the effects of a cold which he had caught before wholly recovering from a previous

cold. A sketch of his life up to that time, embracing the most active parts of his career as a geological explorer, in which he gained great renown, was given, with a portrait, in the Popular Science Monthly for September, 1878. During the period that has intervened he made studies of the results of his explorations and other geological work, and published papers of very high scientific value. About a year ago he transferred his extensive and famous collections at the Peabody Museum to the university. These collections were among the finest of their kind in the world, and were especially remarkable for their fossils of immense animals exhumed from the Western plains. They were greatly admired by Professor Gaudry, the eminent French geologist, who spoke of them in terms of high praise in the *Revue des Deux Mondes* of October 15, 1898. It was through his efforts that the funds were obtained from George Peabody, his uncle, for the construction of the Peabody Museum, a part of which has been built. His health having apparently improved for a few months previous to his death, he had been working with renewed activity at the museum, and had recently written articles on paleontological subjects. Having considerable means of his own, he served the university without salary, and carried on his explorations mostly at his own cost, paying large sums to assistants and for other items in the work. He left ten thousand dollars to the National Academy of Sciences, of which he was one of the founders and was for several years president, and all of the rest of his estate, estimated to be worth nearly one hundred thousand dollars, to Yale University.

Popular Co-operation in Health Work.—In a review of A Quarter Century of Public Health Work in Michigan, Mr. Theodore R. MacClure, chief clerk of the State Board of Health office, says that experience in the State has indicated that it is necessary to have the co-operation of the people if the dangerous communicable diseases are to be restricted and prevented. In order to [Pg 137] accomplish this result, the State Board of Health has published leaflets relating to the modes of spreading and the best methods for the restriction and prevention of such diseases. These leaflets have been printed by tens of thousands, and whenever a dangerous disease is reported to the central office several copies of the leaflet relating to the disease in question are usually sent to the local health officer. He is requested to place one of these instructive publications with the family where the disease exists, and a copy with each neighbor of the infected premises. The instruction comes at a time when people are interested to know about the disease in question, and in this way their general co-operation is sought and secured. Citizens are thus educated and become familiar with their duties in the premises, are taught wherein the dangers lie and how to avoid them, and are prompted by the strongest considerations to do their part in the matter.

Death of Prof. Oliver Marcy.—Dr. Oliver Marcy, professor of natural science in Northwestern University, who died February 19th, in the eightieth year of his age, was a native of Coleraine, Massachusetts; was graduated from Wesleyan University in 1846, became teacher of mathematics in Wilbraham Academy, Massachusetts, and later professor of geology, etc., in that institution. In 1862 he was appointed professor of geology in Northwestern University, Evanston, Illinois, but taught in addition, at times, other branches of science and even some branches in other lines. He was twice acting president of the university. In conjunction with Prof. Alexander Winchell, he prepared a monograph on Fossils from the Niagara Limestone of Chicago, which was read to the Boston Society of Natural History. In 1866 he was naturalist to a Government expedition to the Bitter Root Mountains in Idaho and Montana, in which he collected scientific material, and of which he published an account in 1867. He wrote papers concerning the geology of the shore of Lake Michigan and of the region about Chicago; brought two fossil trees found in the university grounds to scientific notice; and contributed considerably to geological publications. He was curator to the natural history collection of his university for nearly thirty years. Two fossil species and a mountain in Montana have been named after him.

Which is the Fittest to Survive?—Prof. A. W. Rücker spoke in his opening address at the recent meeting of the International Magnetic Conference in Bristol, England, of what seems to be a law of Nature, that the products of an organism are fatal to itself; in accordance with which, he said, pure science is threatened by the very success of its practical applications. The smoke of our cities blots the stars from the vision of the astronomer, and now the science of terrestrial magnetism is threatened by the artificial earth currents of the electric railway. Prof. W. E. Ayrton, in his welcoming address, took another view of the subject and answered the reference the electrical engineers make to the principle of the survival of the fittest when they are told of the ruin their wires are bringing upon magnetic observatories—"So much the worse for the observatories"—"Can the system of electric traction that has already destroyed the two most important magnetic observatories in the United States and British North America be the best and fittest to survive? Again, do we take such care and spend such vast sums in tending the weak and nursing the sick because we are convinced that they are the fittest to survive? May it not be perhaps because we have an inherent doubt about the justice of the survival of the strongest, or perhaps because even the strongest of us feels compelled modestly to confess his inability to pick out the fittest, that modern civilization encourages, *not* the destruction but the preservation of what has obvious weakness, on the chance that it may have unseen strength? When the electrical engineer feels himself full of pride at the greatness, the importance, and the power of his industry, and when he is inclined to think slightingly of the deflection of a little magnet compared with the whirl of his one-thousand-horse-power dynamo, let him go and visit a certain dark storeroom near the entrance hall of the Royal Institution, and while he looks at some little coils [Pg 138] there, ponder on the blaze of light that has been shed over the whole world from the dimly lighted cupboard in which these coils now lie. Then he may realize that while the earth as a magnet has endured for all time, the earth as a tramway conductor may at no distant date be relegated to the class of temporary makeshifts, and that the raids of the feudal baron into the agricultural fields of his neighbors were not more barbarous than the alarms and excursions of

the tramway engineer into the magnetic fields of his friends."

Teaching the Teachers.—The following suggestive paragraph is taken from the inaugural address of William Henry Preece, president of the British Institution of Civil Engineers: "Our educational methods have begun at the wrong end. We ought to teach the masters first and then the men. Moreover, we have to teach the teachers and those who have control of the purse-strings. The County Councils of England are scarcely qualified as yet to discharge the very serious duty of properly dealing with a question so few of them understand—though many of them have tackled the matter manfully, especially the London County Council, through its Technical Education Board, on which a large proportion of co-opted experts have seats, who, by supporting existing institutions, have contributed toward the supply of teachers. But how are we to approach the masters? A fault once discovered is halfway to repair. It is difficult to remove the scales from the eyes of the man who has been successful in business and knows not of his blindness; but the coming generation will be more enlightened, and the future masters better educated. We are suffering from a lack of competent teachers. A teacher who has had no training in the practical world is worse than useless, for he imparts ideas derived from his inner consciousness or from the false teaching of his own abstract professor, which lead to mischief. In my own experience I have met with very serious inconveniences from this cause. The ideal professor of pure abstract science is a very charming personage, but he is a very arrogant and dogmatic individual, and, being a sort of little monarch in his own laboratory and lecture room, surrounded by devoted subjects, his word is law, and he regards the world at large, especially the practical world, as outside his domain and beneath his notice. He is generally behind the age. These are not the men for technical institutes. Such teachers should possess the diploma of this institution."

The People of India and the Missionaries.—In the light of three months' special observation, J. T. Sunderland has reviewed in the New World Magazine the prospects of the success of Christian missions in India. There are several causes that hinder their progress, among which the author mentions as more important the number of Christian sects and denominations; the character of the doctrines preached, in that in many aspects they do not appeal to Hindu or Mohammedan faith or modes of thought, and in some contradict them, and as to those points are a serious hindrance to the progress of Christianity; and the vices of many Europeans, creating a prejudice against their professed religion that is not wholly contradicted by the testimonies and examples of the missionaries and men of nobler stamp. To the last objection the answer is easy, though it may not always be convincing, that these wicked men sin not because they are natural products of Christianity, but because they disobey it. A strong factor in disarming prejudice against Christianity and winning favor for it is the fact that through it, directly or indirectly, certain very important kinds of good are coming to India—education, schools, books, science, invention. The contact of India with Christian lands, civilization, thought, and life, is steadily telling upon Indian thought. Further, "it is to be said to the honor of all the Protestant missions of India, at least, of whatever name, that they are helping, instructing, and lifting up the lower classes, and offering them hopes and prospects such as they could not have had under their old faiths. This is much, very much." The very presence of the missionary in a community is likely to be an enlightening influence. He is a man of more than common education, and "has brought with him to India something of the thought, the culture, the ideals of life, the habits and customs [Pg 139] of the Western world. He introduces higher standards of living. He gives his influence in favor of better public sanitation, better homes for the people, better streets and public buildings, better public improvements generally. His home and family life, in which the wife receives the same consideration as her husband, and the daughters are educated with the same care as the sons, becomes a valuable object lesson in the community where he dwells." The missions as a whole are regarded by the author as an important factor in a great religious evolution. The precise form and direction which this evolution will take seem to be a matter yet to be determined.

Weeds under Cultivation.—For several years past the botanical department of Michigan Agricultural College has maintained a "weed garden," and has grown a hundred or more species of the most troublesome weeds in plots. Some curious results from the experiments are recorded by Prof. W. J. Beal in a paper read at the meeting, 1897, of the Society for the Promotion of Agricultural Science. The most vigorous and aggressive weeds seem to take on under cultivation the weakness and capriciousness of delicate cultivated plants. "It is very instructive," Professor Beal says, "to note how much better many of these plants thrive when they get away from the spot where they have been confined for from two to several years. Seedlings of Jamestown weed were larger in the plantain bed than in their own. After three years the plantain nearly ran out and *Amaranthus albus* entirely disappeared. One species of pigweed grew finely for two years, but afterward made a small display; and another variety did not seem very persistent for a plant that ranked among the weeds, but shied off from its home ground 'as if searching for fresh fields.' Barnyard grass (*Panicum crusgalli*) behaved like pigweed, and 'needed considerable attention.' The little round-leaved mallow, which roots deeply about rubbish piles in mellow soil, was grown of respectable proportions in the garden with considerable difficulty, and with no more ease in the bottom lands of other parts of the botanic garden. Considerable pains is required every year to keep on hand even fairly well-grown specimens of mullein. Knotgrass, which thrives with abuse and seems to enjoy trampling by feet, was grown with difficulty in the plots. 'Insects prey upon it; rust causes it to dwindle and disappear.' 'Motherwort grows rank four feet high near the barnyard fence, and the flowers are covered with bees, but when kept several years in the same bed it goes off into the sulks as though neglected.' Shepherd's purse is often disturbed by a parasitic fungus, and it is difficult to grow nice plants long in the same place. Cocklebur, if found long in the same spot, is troubled sadly with a mildew, and more recently also with a rust."

Operations against Woodchucks.—Prof. F. H. Storer records in the Bulletin of the Bussey Institution, Harvard University, the results of his experiments in the destruction of woodchucks, which, besides being very injurious to lands he had under cultivation, appeared to be increasing. Smothering by a volatile liquid driven into the burrow has been suggested by Professor Hilgard, who recommends bisulphide of carbon. Professor Bussey finds that liquid not wholly satisfactory and liable to objections, and prefers a preparation of naphtha or other volatile liquid. In any event, some device seems to be needed for forcing a considerable quantity of the vapor into the very end of the burrow. Poisons are dangerous because of the probability that the animal would bring the food on which they are placed to the mouth of the burrow for eating, where children or useful animals might get it. While experimenting with burning Cayenne pepper or sulphur on touch paper, in order to smoke out the burrows, the author became acquainted with the "woodchuck torches" of Mr. B. M. Wedger, of Roslindale, Massachusetts. These consist of nitrate of soda, sulphur, mealed gunpowder, and sulphide of antimony, so packed into a tube like a Roman candle that on burning the fuse the vapors would be forced by great pressure to the farthest recesses of the burrow. They proved effectual, and it was indeed rare that any [Pg 140] woodchuck to which they were applied ever reported himself again. Professor Storer also describes some experiments he made in burning sulphur in the burrows, with special expedients for insuring more rapid and perfect combustion of the sulphur; these promised fairly well. Mr. Henry Stewart has described in the Country Gentleman an effectual method of destroying woodchucks with blasting powder or dynamite.

Evolution in Lamps.—The story of lamps from Herodotus down to 1830, Mr. Henry C. Mercer says, in an instructive study on Light and Light Making in the contributions of the Bucks County (Pa.) Historical Society, is not one of development. In principle and form they remain the same, whether as the tin cylindrical or boat-shaped cups on candlestick pedestals and the round tin cups with hemispherical lids, or the lidless cups resting on wooden stands such as were recently rescued by the author from the garret rubbish of old Bucks County. And before Herodotus, as we follow the lamp back into the tombs of the Old World, we find the boat-shaped form of earthenware preceding the boat-shaped form of iron and possibly even that of bronze. The chalk-cup lamp found by Canon Greenwell in the neolithic flint mines at Grimes Graves, England, perhaps the oldest wick-floating lamp in the world, is not essentially different from the oyster shell filled with lard and provided with wicks that may be found among Virginia negroes to-day. The Egyptian, Grecian, Phœnician, and Roman lamps, as they have been found in the tombs and as we see them in the museums, are not unlike the lard lamps that were most in use early in the nineteenth century. Then crude grease gave way to sperm oil and lard oil, with especial adaptations of the lamps that made them more convenient and improved the light; and burning fluids that were convenient and clean and gave a brilliant light, but were dangerous; and kerosene, with other improvements in the lamps and refinements in the oil that enabled it to give the most perfect artificial light yet found and to keep up the fight for quality with gas and electricity—all these having come in within the life-time of men still among us. Besides the old lamps, our ancestors had candles, molded when the price of tin, the material for the molds, did not forbid the luxury, and before them tallow dips; a suspended wick was dipped into a pot of hot tallow, on a cold day, and the operation was repeated till layer after layer of grease hardened, and the candle was thick enough. These candles were, however, troublesome in hot weather, on account of their propensity to yield to the temperature and fall over. "Who shall say, however, that candle-dipping is older than molding, when we know ... that they molded candles in County Galway, Ireland, in late years by punching holes in peat and pouring in tallow on the down-hung wick of twisted flax fiber?" The Irish had, too, as had the negroes, the rush light, a greased rush set in a hole in a wooden block serving as a candlestick; or rushes joined in a triple twist which flies apart when lighted, increasing the blaze. From this Mr. Mercer passes to forms of candlesticks and torches and cressets and methods of producing fire, whither we can not follow him, for the multitude of details he notices, which will not bear abstracting.

Inconsistent Philozoists.—In his address at the opening of the physiological and pathological laboratories at Belfast, Ireland, Lord Lister took occasion to give some illustrations, drawn from practice, of the value of pathological research. "There are people," he said, "who do not object to eating a mutton chop—people who do not even object to shooting a pheasant with a considerable chance that it may be only wounded and may have to die after lingering in pain, unable to obtain its proper nutriment—and yet who consider it something monstrous to introduce under the skin of a guinea-pig a little inoculation of some microbe to ascertain its action. These seem to me to be most inconsistent views. If these experiments upon the lower animals were made for the mere sport of the thing, they would be indeed to be deprecated and decried; but if they are made with the wholly noble object of not only increasing human knowledge, but also of diminishing human suffering, then I hold that such investigations are deserving of all praise. Those little know who [Pg 141] lightly speak on these matters how much self-denial is required in the prosecution of such researches when they are conducted, as indeed they always are, as far as I am aware, with the object of establishing new truth."

The Ruins of Xkichmook, Yucatan.—The group of ruins in Yucatan called Xkichmook was discovered by Mr. Edward H. Thompson in 1888, when he read a paper before the American Antiquarian Society embodying his first impressions of it. He has since made studies of it extending over a period of seven years. The group is about one hundred and forty miles south of Merida and forty or fifty miles east of Campeche, situated in a narrow valley between a series of rocky hills, and has to be approached by precipitous paths over the hillsides, and thence down the beds of dry *arroyos* whose yearly freshets wash away all vegetation. Ten buildings, including

one called the Palace, and two mounds were explored, and some miscellaneous excavations were made—all of which are described in the author's paper (Field Columbian Museum), with figures of the buildings and objects. Pottery and flaked stone implements were plentiful, but polished implements and specimens of sculpture were exceedingly rare. The flat under surfaces of the ceiling stones of the vaulted chambers seem to have contained very elaborate designs; in another chamber portions of a painting were still partly preserved; in another, curious drawings or glyphs in strong black lines once existed; in another was a painted human figure, of which only the flowing headdress, a portion of the face, and certain devices issuing from the mouth and probably indicating speech, now remain. The mysterious red hand was found painted in various places, and in one a human hand in blue pigment was found, the impression of which was so fresh and perfect in places that even the minute lines of the skin were visible. In ten years of investigation among the ruins of Yucatan and Campeche not as many specimens of worked obsidian were found as could be picked up in half an hour among certain Mexican ruins; but traces of ancient fabrication of flint implements were more plentiful than anywhere else.

The Seventeen-Year and the Thirteen-Year Locusts.—The periodical cicada, or seventeen-year locust, as it is called, is distinctly American, and has the longest life period of any known insect. It is especially remarkable, Mr. C. L. Marlatt observes in his memoir upon it, in its adolescent period, the features of particular divergence from other insects being its long subterranean life of thirteen or seventeen years, and the perfect regularity with which at the end of these periods every generation, though numbering millions of individuals, attains maturity almost at the same moment. At this moment the brood issue from the ground, leaving innumerable exit holes, and swarm over trees and shrubs, filling the air with their strident calls, and laying their eggs in slits which they cut in the trees. The larvæ, when hatched, fall to the ground, and quickly burrow out of sight, each "forming for itself a little subterranean chamber over some rootlet, where it remains through winter and summer, buried from sun, light, and air, and protected in a manner from cold and frost.... It lives thus alone in its moist earthen chamber," rarely changing its position unless some accident to the nourishing rootlet may necessitate its seeking another, passing the thirteen or seventeen years of its hypogeal existence in slow growth and preparation for a few weeks only of winged life in the air and light. Other cicadas appear every year, usually in comparatively small numbers. They are probably equally long in maturing, but the periods of their lives have from some cause or another been cast in "off" years. The thirteen-year broods are southern, and the shortening of their periods of development may possibly be accounted for by the longer season of warmth in the southern year giving them the number of hours or of aggregate degrees of warmth in thirteen years that the more northern broods can not receive in less than seventeen years. This, however, is only speculation, and there are difficulties in applying the supposition to make it fit all the facts; and many believe that the two races are specifically different. The late Prof. Charles V. Riley distinguished twenty-two different broods of cicadas in the United States, seven of which appertain to the thirteen-year period (*Cicada tredecem*). [Pg 142]

MINOR PARAGRAPHS.

The Bureau of Nature Study of Cornell University is making a praiseworthy effort to interest children in caring for birds, or, as its circular has it, treating them as "summer boarders." It publishes a leaflet entitled The Birds and I, which it sends free to teachers who ask for it and who will give it to their pupils. It has pictures of various styles of bird houses, which may serve as patterns for the construction of homes for the summer guests. "The kind of birds," the interesting circular of the bureau says, "that will set up housekeeping in the homes that you provide will harm no one. They are never cross, never throw stones or rob us, but are always happy and have cheerful songs. We are always kind to people having such dispositions, and why should we not be so to birds as well?" The bureau invites correspondence from boys and girls disposed to entertain birds.

The National Geographic Society offers prizes of one hundred and fifty dollars and seventy-five dollars severally for the first and second best essays relating to pre-Columbian discoveries and settlements of the Norsemen on the mainland of North America, and the location of the lands mentioned in the Icelandic Sagas, the competition to close December 31, 1899. The essays sent in should be typewritten in the English language, not exceeding six thousand words in length, and may be accompanied by maps and illustrations for explanation of the text, but not for embellishment. The committee of awards consists of Mr. Henry Gannett, Prof. Albert Bushnell Hart, Mrs. Anita Newcomb McGee, Prof. John Bach McMaster, and Coast Survey Superintendent Henry S. Pritchet.

Experiments by a German naturalist, Herr Albrecht Bethe, summarized in the *Revue Scientifique*, upon recognition of one another by ants, confirm the opinions of Lubbock, McCook, Forel, and others that they are guided by the sense of smell. Herr Bethe found that an ant "whitewashed" with liquid of ants of its own nest was well received by its fellows when it went among them; but when the liquid of ants of a different nest was applied it was attacked at once. An ant washed with alcohol, next with water, and then with the liquid of a strange species was well received in a nest of that species, although it was much smaller than any of the individuals composing it. Another ant washed with alcohol and water, dried, and immediately returned to its fellows of its own nest, was attacked by them; but when kept for twenty-four hours after drying, or long enough to recruit itself, was received by them.

The following tables are taken from a paper by Dr. J. Richardson Armstrong in a recent Lancet,

describing his experience with diphtheria antitoxine in private practice in treating one hundred and twenty-two cases of diphtheria:

		Recovered.	Died.
1.			
Total number of cases treated from June 27 to Dec. 17, 1897	42	36	6
Severe cases; antitoxine injected	22	20	2
Mild cases; antitoxine not injected	20	16	4
2.			
Total number of cases treated, January 1 to December 31, 1898	80	77	3
Severe cases, injected	55	54	1
Mild cases, non-injected	25	23	2

In answer to the question, Should every case of diphtheria be treated with antitoxine, Dr. Armstrong says: "Some of the cases are sufficiently mild not to need it, so I will not go so far as to say that it is absolutely essential to inject in every case, although I would call it an excellent practice to do so, and the patients would make much more rapid recoveries. I think that injection [Pg 143] ought to be insisted upon as early as possible in every case that is at all severe or likely to prove so, and I think that the medical man who does not employ antitoxine and who loses a large proportion of his cases is incurring a responsibility which is almost criminal. The earlier a patient is injected the greater is the chance of recovery, and the more rapid is the recovery."

Among the leading principles of forestry, as defined by the chief fire warden of Minnesota, are that the best agricultural land should not be devoted to forest while wood and timber can be profitably grown on soil that is unfit for farming purposes; that the management should be continuous, and no more timber should be taken out of the forest in one year, or in a series of ten or twenty years, than grows in the entire forest in the same period; that the cutting of timber should be in blocks or strips, so as to facilitate reproduction on the clear areas by seeds falling from the trees left standing; and that the forest, when young, must have in numbers vastly more trees than when it is mature. To make good timber, the forest, when young, must be crowded so as to secure height growth. Mixed wood, managed on forestry principles in the Black Forest of Germany, has per acre, at the age of twenty years, 3,960 trees; at the age of one hundred years, 262 trees.

A new process for the production of a textile material is thus described in Industries and Iron: "It consists of 'squirting,' in a fashion similar to that of making electric incandescent carbons, pure gelatin in threads of about one thousandth part of an inch in diameter, the thread being taken away on revolving tapes. The threads are wound upon reels and exposed to formalin vapor, which exercises a most remarkable effect on the gelatin, rendering it insoluble in any medium yet applied to it. The tensile qualities of the thread are also increased, while, in opposition to that produced under the Lehner process (which is simply forming nitrated cellulose into threads for weaving), it is capable of taking up any dye desired; and it is, of course, impervious to any hygroscopic influence.

NOTES.

Prof. E. C. Pickering, of the Harvard College Observatory, announces the discovery by Mrs. Fleming of a new variable star in Sagittarius. It was found on eight of the photographs in her large collection. On March 8, 1898, it was of the fifth magnitude, and on April 29, 1898, of the eighth magnitude. A plate taken on March 9, 1899, shows it still visible and of the tenth magnitude. Its spectrum resembles that of other new stars. The entire number of new stars discovered since 1885 is six, of which five have been found by Mrs. Fleming.

Because of the great loss by fire which occurs every year in the Russian villages, the government is making efforts to induce the peasantry, says the *Saturday Review*, to employ some less dangerous material than straw thatch for the roofing of their *izbas*. There has already been a large increase in the use of shingle, and this has led to a considerable importation from Belgium and Germany, and also from the United States, of simple and inexpensive shingle making machines, for use in rural districts. German manufacturers, whose "commercial intelligence department" is remarkably well informed, are now making redoubled efforts to meet the immense demand anticipated. An improved and inexpensive hand fire engine is also being provided. Roofing felt or paper is very generally used under the shingle, and the demand for this is also increasing.

A fourth specimen of the *Notornis Mantelli*, a bird of New Zealand supposed to have become extinct, was captured in August last, and has been prepared for the museum by Mr. W. B. Benham. The first specimen was obtained, recently slain, by Mr. W. Mantell, in 1849, and is preserved in the British Museum; the second was killed by Maoris in 1851, and is in the Colonial Collection; and the third, now in the Dresden Museum, was taken in 1879. All these birds were found in a single denuded region of the country. The present specimen was caught by a dog in the bushes near Lake Te Anan, still in the same region, and is a very fine young female.

A plant growing in the dense jungles of Langsuam, Siam, was described by H. Warington Smyth, in an address to the Royal Geographical Society, as having the property of setting up a great irritation in the skin of any person coming in contact with it. "It has a large, broad leaf, and the Siamese declare that, after being badly stung by it, the only remedy is the heat of a fire; to bathe

in a stream, which is the natural impulse, is considered absolutely fatal. A spot on the Kra-Champawn trail is known as *Burmatai*, from the fact that a party of Burmese, coming across to harry their neighbors in the old fighting days, are said to have got into a thick growth of this plant, and to have bathed in the stream to allay the agony, with the result that they all died there." The Siamese call the plant *kalang-ton chang*. [Pg 144]

In the western part of Belgium the dog has been employed as a beast of burden from time immemorial. The Belgian dog (known only by this name) is a large, compactly built animal, measuring from twenty to thirty inches in height; the hair is smooth and short, generally tan or dark brown in color. It is the custom to crop both ears and tail. The dogs are usually driven before carts weighing from one hundred to one hundred and twenty pounds, in teams of from two to six abreast. A harness very similar in arrangement to that of the horse is used. Six of these animals will draw from six to eight hundred pounds. They are put to work when about a year old. They vary in price from twenty-five to sixty shillings. There are over two thousand dogs in Ghent licensed as draught animals.

A plant described by M. Henri Chantrey as most probably answering to the manna found by the Hebrews in the desert is the thallophyte *Canona esculenta*, or edible lichen, which grows in the deserts of Persia, Arabia, Mesopotamia, and Sahara. It is a grayish cryptogam of about the size of a pea, bearing short bracteate appendages on its top; when cut, it resembles a mass of dull white flour paste. It is an ephemeral substance, and must be collected the morning it appears, as it will soon dry up; but when properly prepared it can be kept in a close vessel. It is highly appreciated by the wandering Arabs, who have often been saved by it from starvation, and they lay up stores of it when opportunity offers. It is easily collected, for it never adheres to any foreign body, and, so far as appearance goes, seems as if it might have been thrown on the ground. There is but little suggestion of the mushroom in its taste, which is rather starchy, with a slight flavor of sugar. Cattle are very fond of it. The Arabs boil it into a gelatinous paste, which they serve in various ways. They preserve it by drying it in the shade and pack it in bladders or skins. It is not a complete first-class food, but is very good for a few days till something better can be got.

The Jernkontoret of Sweden is an ironmasters' exchange at Stockholm, which was founded in 1747 for the financial convenience of the subscribers, and now possesses a reserve fund of about $1,500,000. The functions of the society have been considerably enlarged since its institution. It has organized a corps of mining engineers and metallurgists, who receive salaries from it, and further from manufacturers whom they may serve. They are often commissioned to go abroad and obtain information and practical hints bearing upon their profession. The institution is supported by a light assessment on the production of its constituency. It has a fine building, and publishes an annual volume in *Jernkontorets Annalen*, containing original memoirs and reports from technical agents, which is sent gratuitously to all the masters of forges in Sweden, and is sold abroad.

In a number of glass mirrors of the third and fourth centuries, examined by M. Berthelot, the glass was coated with a metallic substance and with a layer of whitish material. The metal proved to be lead, with no trace of gold, silver, copper, tin, antimony, or mercury, and no sign of organic substance was present. It was thus shown that no extraneous material was used to cement the lead to the glass. The mirrors appeared to have been cut from hollow blown glass globes, and it is possible that before the globe was cut the molten lead had been poured into the interior, and had adhered to the previously warmed glass. The whitish layer consisted of lead carbonate and lead oxide formed by the oxidation of the lead coating and calcium carbonate, which had been deposited from the water of the district in which the mirrors were found.

The list of recent deaths among men known in connection with science and its applications includes the names of Prof. Karl Müller, botanist, one of the founders of the German scientific weekly, *Die Natur*, February 9th, aged eighty-one years; Sir John Struthers, emeritus professor of anatomy in the University of Aberdeen, in his sixty-seventh year; John Kreusi, mechanical engineer and inventor, at Schenectady, N. Y., January 22d, aged fifty-six years; Thomas Cook, teacher of anatomy and author of works on the subject, in London, February 8th; Dr. A. Veitmeyer, civil engineer, in Berlin; Dr. Carl Schoenlein, of the Zoölogical Station at Naples, aged forty years; Major-General Joseph J. Reynolds, of the United States Army, formerly professor of mechanics and engineering at Washington University, St. Louis, February 26th, aged seventy-seven years; Dr. Alexandre Laboulbène, professor of the history of medicine in the University of Paris, and author of a treatise on pathological anatomy and a book on French entomological fauna, aged seventy-three years; Dr. Philipp J. J. Valentini, Americanist and student of ancient Mexican and Central American monuments and codices, in New York, March 16th, in his seventy-first year; Gustave Wiedmann, professor of physics and chemistry in the University of Leipsic, and writer on electricity and magnetism; and Major J. Evans, professor of pathology in the Calcutta Medical College, March 13th.

FOOTNOTES:

[1] Advance sheets from The Races of Europe, now in the press of D. Appleton and Company, to appear in May. Footnotes and references are herein largely omitted.

[2] Popular Science Monthly, January, 1898, pp. 304-322.

[3] Le Mirage Orientale, 1893 a; and in his admirable outline of sculptural origins in Europe (1894-'96).

[4] Arii e Italici, Torino, 1898, especially pp. 199-220.

[5] Reinach, 1893 a, pp. 543-548. G. de Mortillet, 1897, denies the claim.

[6] Chantre, 1884; Hoernes, 1892; Bertrand and Reinach, 1894 a; Sergi, 1898 a; and Orsi (Bull. Paletnologia Italiana, xi, 1885, p. 1 *et seq.*) are best authorities. See also Hallstatt in the subject index of our Bibliography, soon to be published as a Special Bulletin of the Boston Public Library.

[7] Hoernes, 1892, p. 529; Bertrand, 1876 a, second edition, pp. 207-216, fixes about 800 B. C.; but 1894 a, p. 80, carries it back to 1200-1300 B. C.

[8] Zuckerkandl, 1883, p. 96.

[9] Weisbach, 1897 b.

[10] This fact has been established beyond doubt by the recent great work of Studer and Bannwarth, Crania Helvetica Antiqua, 1894. *Vide* p. 13. Sergi's attempt to interpret the data otherwise (1898 a, p. 67) is entirely erroneous. Gross's data apparently refer entirely to the later period of Teutonic invasions in the iron age (1883, p. 106). *Cf.* Munro, pp. 537 and 541.

[11] Popular Science Monthly, December, 1897, p. 151.

[12] From Montelius, 1897.

[13] *Cf.* maps and data in J. Geikie, 1894; Penck, 1884; and Niederle, 1893, p. 25.

[14] Bertrand, 1876 a and 1876 b, gives a full account of it. The best recent authorities upon Scandinavian culture are Sophus Mueller, 1897, and Montelius, 1895 b. Other works of reference are those of Worsaae, Nilsson, Hildebrand, Madsen and Rygh, full titles being given in our supplementary Bibliography of the Anthropology and Ethnology of Europe. Comprising nearly two thousand titles, it will be provided with a detailed subject index.

[15] Bertrand, 1876 b, p. 40.

[16] Reinach, 1892, pp. 72-78, for severe criticism of Penka's hypotheses.

[17] Compendium of the Tenth Census of the United States, Part II, p. 1659. See documents in the new statistical laboratory, the only one in Italy, of Professor Cognetti, recently published at Turin.

[18] Bodio. Bulletin de l'Institut international de Statistique, 1889, pp. 112 and 128. See some Sanitary Statistics in Italy and other European States, by Dr. Rasori.

[19] Haikwan tael, 74.9 cents.

[20] Yen, 52.9 cents.

[21] Peso, gold, 96.5 cents.

[22] Milreis, paper (1896), 20-1/2 cents.

[23] Peso, gold.

[24] Soler, 43 cents.

[25] Dollar (47 cents) for exports, gold dollar for imports.

[26] Peso, $1.

[27] Bolivar, 19.3 cents.

[28] Rupee, 32 cents. For Straits Settlement and Ceylon, Mexican dollars @ 47 cents.

[29] Codrington. The Melanesian Languages.

[30] See Henle. Poetische Personification.

[31] Contributions to the Ethnology and Philology of the Indian Tribes of the Missouri Valley. Dr. F. V. Hayden, 1862.

[32] The Native Calendars of Central America and Mexico. Daniel G. Brinton.

[33] Popular Science Monthly, vol. xlv, article Astronomy of the Incas.

[34] Les Origines Indo-Européennes. Pictet, p. 568.

[35] See a paper by G. K. Schneider in vol. ii of Vierteljahrsschrift für wissenschaftliche Philosophie.

[36] "It is perfectly certain that two in every three children are irretrievably damaged or hindered in their mental and moral development in the schools; but I am not sure that they would fare better if they stayed at home."—Baldwin, in *Mental Development*, p. 38.

[37] See an instance clearly elucidative of this in an account of the Kelly murder trial, given by Dr. Walter Channing in the American Journal of Insanity for January, 1898, page 385.

[38] See New York Medical Journal for August 14, 1897.

[39] See also Dr. Edward Cowles. Shattuck Lecture on Neurasthenia.

[40] See Peterson. The Stigmata of Degeneration. State Hospitals Bulletin, vol. i, p. 327.

[41] The Last Link. Our Present Knowledge of the Descent of Kan. By Ernst Haeckel. Adam and Charles Black. 1898.

[42] Rivers of North America. A Reading Lesson for Students of Geography and Geology. By Israel C. Russell. New York: G. P. Putnam's Sons. Pp. 327. Price, $2.

[43] The Structure and Classification of Birds. By Frank E. Beddard. London and New York: Longmans, Green & Co. Pp. 548.

[44] Bush Fruits. A Horticultural Monograph of Raspberries, Blackberries, Dewberries, Currants, Gooseberries, and other Shrublike Fruits. By Fred W. Card. New York: The Macmillan Company. Pp. 537. Price, $1.50.

[45] The History of the World, from the Earliest Historical Time to the Year 1898. By Edgar Sanderson. With Maps. New York: D. Appleton and Company. 1898.

[46] Life, Death, and Immortality, and Kindred Essays. By William M. Bryant. New York: The Baker & Taylor Company.

[47] Elements of Sanitary Engineering. By Mansfield Merriman. New York: John Wiley & Sons. London: Chapman & Hall, Limited. Pp. 216. $2.

[48] An Epitome of Human Histology. By Arthur W. Weysse. New York: Longmans, Green & Co. Pp. 90. Price, $1.50.

[49] Elementary Botany. By George Francis Atkinson, Ph. D. New York: Henry Holt & Co. Pp. 444. Price, $1.25.

[50] A History of Japanese Literature. By W. G. Aston, Late Japanese Secretary to H. M. Legation, Tokyo. D. Appleton and Company.

[51] An Elementary Text-Book of Botany. By Sydney H. Vines. London: Swan, Sonnenschein & Co. New York: The Macmillan Company. Pp. 611. Price, $2.25.

[52] Animated Pictures. An Exposition of the Historical Development of Chronophotography, its Present Scientific Application and Future Possibilities, and of the Methods and Apparatus employed in the Entertainment of Large Audiences by Means of Projecting Lanterns to give the Appearance of Objects in Motion. Washington, D. C.: C. Francis Jenkins. Pp. 118, with plates.

Transcriber's Notes:

Obvious printer's errors have been repaired, other inconsistent spellings have been kept, including inconsistent use of hyphen (e.g. "air ship" and "air-ship"), diacritical marks (e.g. "êtat" and "état"), and proper names (e.g. "Dostoievski" and "Dostoiewski").

Some illustrations were relocated to correspond to their references in the text.

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