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WILLIAM JAY YOUMANS

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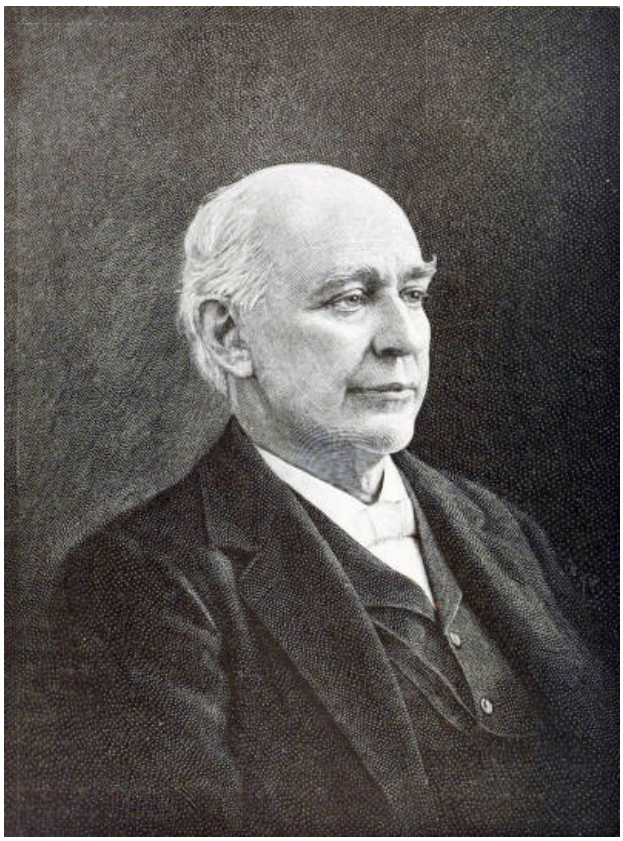

EDWARD ORTON.

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APPLETONS'
POPULAR SCIENCE
MONTHLY.

MARCH, 1900.

THE TRANSPLANTATION OF A RACE.

By N. S. SHALER,
DEAN OF THE SCIENTIFIC SCHOOL OF HARVARD UNIVERSITY.

The experiments which have been intentionally or accidentally made in transplanting organic species from the countries in which they have been developed to others of diverse soil, climate, and inhabitants are always of much interest to the naturalist—each of them affords indications of some value as to the relations of species to what we term "environment." In almost all instances we find that the transplanted forms undergo changes in consequence of the alteration of their circumstances. It is true that certain of our domesticated animals, such as the horse, the dog, and most cattle, follow men from the Arctic to the Antarctic Circle, and that sundry insect pests appear to demand nothing of Nature save the presence of man; yet, as a whole, the creatures we have turned to use, both plant and animal alike, have shown themselves incapable of accommodating themselves to conditions of temperature differing much from those in which they were developed. With hardly an exception, species or varieties which have been developed in the tropics perish when called on to withstand the winter of higher latitudes. Few, indeed, do well when taken to stations where the heat or the humidity differs greatly from that to which they are accustomed.

The intolerance of organisms to climatal changes is nowhere more evident than in the varieties, or species, as we would term them, of mankind. It is a well-attested fact that none of the tropical races has ever of its own instance colonized in the temperate zones. It is also clear that none of the northern peoples have ever become [514] fully acclimated within the tropical realm. The colonies which have been founded there by the Teutonic folk, including the English group therein, have been lamentable failures, the pure-blooded strains dying out in a few generations. The people of southern Europe have been a little more successful in the equatorial regions, probably because their blood has there to a great extent become mingled with that of tropical origin. These general conclusions concerning the climatal limitations of man would be unassailable were it not for the history of the negro in North America. In his case we have the one masterful exception to the rule, otherwise good, that creatures bred near the equator can not endure boreal conditions.

The negroes who came to North America had to undergo as complete a transition as ever fell to the lot of man, without the least chance to undergo an acclimatizing process. They were brought from the hottest part of the earth to the region where the winter's cold is of almost arctic severity—from an exceedingly humid to a very dry air. They came to service under alien taskmasters, strange to them in speech and in purpose. They had to betake themselves to unaccustomed food and to clothing such as they had never worn before. Rarely could one of the creatures find about him a familiar face of friend, parent, or child, or an object that recalled his past life to him. It was an appalling change. Only those who know how the negro cleaves to all the dear, familiar things of life, how fond he is of warmth and friendliness, can conceive the physical and mental shock that this introduction to new conditions meant to them. To people of our own race it could have meant death. But these wonderful folk appear to have withstood the trials of their deportation in a marvelous way. They showed no peculiar liability to disease. Their longevity or period of usefulness was not diminished, or their fecundity obviously impaired. So far as I have been able to

learn, nostalgia was not a source of mortality, as it would have been with any Aryan population. The price they brought in the market and the satisfaction of their purchasers with their qualities shows that they were from the first almost ideal laborers. If we compare the Algonkin Indian, in appearance a sturdy fellow, with these negroes, we see of what stuff the blacks are made. A touch of housework and of honest toil took the breath of the aborigines away, but these tropical exotics fell to their tasks and trials far better than the men of our own kind could have done.

At their first coming, or soon afterward, the negroes were distributed along the coast of our country from the Carolinas to Nova Scotia. So far as I have been able to find, there appears to have been no distinct difference in their tolerance of the climate in [515] any part of this varied district. There are still negroes in the maritime provinces who are said to be the descendants of those who came upon the ground certainly more than a century ago. They are good specimens of their stock. So, too, along the New England coast and in New York there is a sufficient number of the progeny of those once held as slaves to make it clear that the failure to become a considerable part of the population in that district is not due to any incapacity to withstand the climate. The failure of the negro to increase in this field can be accounted for in other ways—by the effects of race prejudice, nowhere stronger than in this part of the country, and by the vice and misery that overtake a despised lower class.

It early became evident that slavery was to be of no permanent economic advantage to any part of the colonies within the glaciated district, say from central New Jersey northward. In that portion of the coastal belt the state of the surface and the character of the crops alike tended to make the ownership of slaves unprofitable. The farms were necessarily small. They became in a natural way establishments worked by the head of the house, with the help of his children. Such other help as was needed was, in the course of two generations, readily had from hired white men and women. It was otherwise in the tobacco-planting region to the southward. The cultivation of that plant, to meet the extraordinary demands that Europe made for it, gave slavery its chance to become established in this country. But for that industry the institution would most likely have taken but slight root, and the territory as far south as North Carolina would have been in social order not very different from Pennsylvania, New York, and the New England settlements. But, owing to some peculiar, as yet unrecognized, adjustments of climate and soil, tobacco for pipes has a quality when grown in the Virginia district such as it has nowhere else in the world, and the world turned to smoking it with a disregard for expense that made each laborer in the field worth some hundred dollars a year. Moreover, the production of good tobacco requires much care, which extends over about a year from the time the seed is planted. Some parts of the work demand a measure of judgment such as intelligent negroes readily acquire. They are indeed better fitted for the task than white men, for they are commonly more interested in their tasks than whites of the laboring class. The result was that before the period of the Revolution slavery was firmly established in the tobacco-planting colonies of Maryland, Virginia, and North Carolina. It was already the foundation of their only considerable industry.

Although the production of tobacco had made slavery a great [516] economical success in the limited field where the best product was to be had, it is doubtful if the institution would have attained to any widespread importance but for the development of another form of planting—that of cotton. Thus, in Kentucky, where the crops, with the exception of a coarse tobacco, are the same as in the other Northern States of the Union, the institution, despite the long-continued scarcity of labor, never attained any very great development. The slaves were generally used for household service, but to no great extent in the fields, and in such employment only in the districts where the soil was of such great fertility that large quantities of grain were raised for export. In one third of that Commonwealth negroes were, and remain to this day, quite unknown. The invention of the cotton gin ended all hope that slavery might be limited to a part of the seacoast region, for nearly all of the lowland regions of the South, as well as some of the upland country north to the southern border of Kentucky and Virginia, are admirably suited to that crop—producing, indeed, a better "staple" than that of any other country. This industry, even more than that of

raising tobacco, called for abundant labor which could be absolutely commanded and severely tasked in the season of extreme heats. For this work the negro proved to be the only fit man, for while the whites can do this work they prefer other employment. Thus it came about that the power of slavery in this country became rooted in its soil. The facts show that, based on an ample foundation of experience, the judgment of the Southern people was to the effect that this creature of the tropics was a better laborer in their fields than the men of their own race. Much has been said about the dislike of the white man for work in association with negroes. The failure of the whites to have a larger share in the agriculture of the South has been attributed to this cause. This seems to me clearly an error. The dislike to the association of races in labor is, in the slaveholding States, less than in the North. There can be no question that if the Southern folk could have made white laborers profitable they would have preferred to employ them, for the reason that the plantations would have required less fixed capital for their operation. The fact was and is that the negro is there a better laboring man in the field than the white. Under the conditions he is more enduring, more contented, and more trustworthy than the men of our own race.

The large development of the cotton industry in this country came after the importation of negroes from Africa had ceased to be as completely unrestricted as it was at first. The prohibition of the traffic came indeed before the needs of laborers in the more [517] Southern and Western slave States had been met. For a while there was some surreptitious importation, which in a small way continued down to the middle of this century, but this smuggling was quite insufficient to supply the market of the new States with slaves. The result was that the border slaveholding States became to a considerable extent the breeding grounds for men and women who were to be at maturity exported to the great plantations of Alabama and Mississippi, there to be herded by overseers in gangs of hundreds, with no hope of ever returning to their kindred. With this interdiction of the foreign slave trade the evils of the former situation became magnified into horrors. The folk who were brought from Africa came from a state of savagery to one of relative comfort. When once adjusted to their new conditions, their lot was on the whole greatly bettered. But their descendants, who had become attached to the places where they were born with the peculiar affection the better of them had for their homes, being accustomed to masters who on the whole were gentle, were now to undergo a worse deportation than that which made them slaves. It is not too much to say that the deeper evils of the system to the slaves themselves, as well as to their masters, began with this miserable slave trade that went on within the limits of this country, and was about at its height when the civil war began.

It can not be denied that even in the best stages of slaveholding there had been a good deal of commerce in slaves where the feelings of these chattels were in no wise regarded. Still, there was a prevailing sentiment among all the slaveholders of the gentler sort that it was in a way disgraceful to part families. I distinctly recall, when I was a lad, some years before the civil war, my maternal grandfather often charged me to remember that I came of a people who had never bought or sold a slave except to keep families together. I know that this was a common feeling among the better men of Kentucky and Virginia, and that the practice of rearing negroes for the Southern market filled them with sorrow and indignation. Yet the change was the inevitable result of the system and of the advancing commercialism which separated the plantation life more and more from that of the owner's household. At the time when the civil war began the institution of slavery was, from the commercial point of view, eminently successful. Notwithstanding the occasional appearance of the spendthrift slave owner in Northern pleasure resorts or in Europe, the great plantations were generally in charge of able business men, who won a large interest on their investments and who were developing the system of planting in a way which, though it appeared to those who were [518] accustomed to close tillage as shiftless, was really well adjusted to the conditions. Not one fourth of the land of the Southern States that was well fitted for the work of slaves had been brought into use. The blacks who were carefully managed in all that regarded their health and in their morals, so far as might affect their breeding, were in admirable physical condition, and rapidly

increasing in numbers. It is doubtful if ever a peasant class was so well cared for or so freed from avoidable diseases. The growing protest against the institution, so far as it operated in the South, was practically limited to the border States, mainly to Kentucky, where alone did a considerable number of well-born men set themselves against it. There is good reason to believe that if the civil war had not occurred the end of the nineteenth century would have seen a negro population in the South much more numerous than we now have there. Experience has shown that the American cotton crop is little affected by foreign competition, so that it would have maintained the success of the institution.

Although the system of slavery was by a chance of Nature so firmly planted on the cotton fields as to give it entire dominance in the South, and something like control of the Federal Union, there was one geographic condition that menaced its future, and in the end did much to insure its downfall in the events of the civil war, and most likely would have brought about its end even if the Confederacy had been established. This was the form and extent of the Appalachian uplands between the Potomac and the Ohio on the north and Alabama and Georgia in the South. In this area of nearly one hundred and fifty thousand square miles in extent the surface lies at an average height of some fifteen hundred feet above the sea; the good arable land is found mostly in narrow valleys suited only for household farms, totally unfit for the systematic agriculture in which alone negroes could be profitably employed as slaves. Into this area drifted the class of small farmers who by one chance and another had never been able to enter or to maintain themselves in the aristocratic class of slaveholders. These mountaineers—they may better be termed the hill people of the South—were an eminently peculiar people. They are not to be compared with the "poor white trash"—i.e., the downfallen and dependent whites, who were broken men in spirit, scarce above the slaves in quality. These poor whites were often, if not generally, either the weaker strains of the militant families or the descendants of the people who had been imported into this country by the land companies or sent out as peons.

Partly because of their separation from the slaveholding class [519]
and partly because of the circumstances of their origin, the people of the Southern highlands formed a curiously separated class. They retained the quality of their English stock, as they had brought it with them—an independence, a carelessness as to life, and a humor for quarreling with those who were set above them whenever their liberties or their license seemed to be threatened. Even their customs and utensils held with curious adhesion to the usages of earlier centuries. Thus, in 1878, I found, in a secluded valley of southwestern Virginia, men hunting squirrels and rabbits with the old English short bow. These were not the contrivances of boys or of to-day, but were made and strung and the arrows hefted in the ancient manner. The men, one of them old, were admirably skilled in their use; they assured me that, like their fathers before them, they had ever used the bow and arrow for small game, reserving the costly ammunition of the rifle for deer and bear. These hill folk were, in a passive but obdurate manner, opposed to slavery, and even more to negroes. There are still many counties in this district where a negro has never dwelt. In some parts of it I have had people gather from twenty miles away to stare at my black camp servants, as the folk of central Africa are said to do at a white man.

At the outbreak of the civil war the Appalachian upland was still thinly peopled; it was, however, fitted to maintain a population of some millions. If the Confederacy had won its independence, its plantation districts, with a relatively small voting population, would soon have had to settle an account with the people of the hills. As it was, the existence of this folk in a great ridge of country extending from the Northern States to within two hundred miles of the Gulf of Mexico was an element of weakness which went far to give success to the Federal arms. It kept Kentucky from seceding, prevented the region of West Virginia from being of any value to the rebellion, and weakened its control in several other States. In all, somewhere near one hundred thousand recruits came to the Federal army from this part of the South. It is not improbable that to this folk we may attribute the failure of the great revolt. That they turned thus against the people of their own States to cast in their lot with those who were strangers to them shows their feelings toward the institution of slavery; it indicated where they would have stood if the

Confederacy had been established.

It is not easy to picture the condition of the negro population in 1860. There is a common notion that it was consciously and bitterly suffering from its subjugation—ready to rise in arms against its oppressors. This view was indeed shared by the Southern people, [520] who lived in chronic fear of insurrections. The error of it arose from the fallacious notion that the people of another race must feel and act as we would under like circumstances. The facts showed that the negro mind does not work in the fashion of our own. He had, it is true, suffered from slavery, but not as men of our race would have suffered. Against its deprivations and such direct cruelty as he experienced, not often great, he could set the simple comforts and small pleasures which are so much to him. That he was on the whole fairly contented with his lot, that his relations with his masters were on the whole friendly, is shown by his remarkable conduct during and since the civil war. If the accepted account of the negro had been true, if he had been for generations groaning in servitude while he passionately longed for liberty, the South should have flamed in insurrection at the first touch of war. We should have seen a repetition of the horrors of many a servile insurrection. It is a most notable fact that, during the four years of the great contention, when the blacks had every opportunity to rise, there was no real mark of a disposition to turn upon their masters. On thousands of Southern farms the fighting men left their women and children in the keeping of their slaves, while they went forth for a cause whose success meant that those slaves could never be free.

That the negroes desired to be free is plain enough. The fact that they fled in such numbers to our camps shows this. Their failure to revolt must be taken as an indication that their relations with their masters measured on their own instinctive standards were on the whole affectionate. They had the strength to have made an end of the war at a stroke. They were brave enough for such action. That they did not take it after the manner of their kindred of Santo Domingo is the best possible testimony as to the generally sympathetic relation which existed between master and slaves. Of this no better test can be imagined than that which the final stages of the institution afforded.

In taking account of the history of the slave in this Union it is not amiss for me to bear testimony as to the spirit with which the body of our slave owners met the singular obligations of their positions. There were here and there base men who abused their trust as masters—some, indeed, who never perceived its existence. But of the very many slave owners whom I can remember I can recall but three who failed to recognize the burden that fate had put upon them and to deal with it much as they dealt with the other cares of their households—conscientiously and mercifully, though often in the rude whacking way in which parents of old dealt with their children; so far as slavery was a household affair, and even where [521] the farm employed no more hands than could be gathered in a house "quarter," the people were commonly subject to an anxious scrutiny as regarded their moral and religious training. Here and there, especially when there were young white men about, the result was the deplorable mixture of the races. There is no question but that this was extensive, though the amount of it is exaggerated. Yet it was common enough to degrade the whites and to make of itself a sufficient reason for ending the institution, however profitable it might otherwise have been. Men of no race are safely to be trusted with such power. The social evil was the heaviest part of the load which the high-minded slave owners had to bear. It was shared in even larger measure by his wife and daughters. How heavy the cross was can only be known to those who remember the conditions of that unhappy time.

The result of the hopeless effort to keep the slaves in decent ways and to prevent the pollution of their sons was to make nearly every right-minded slaveholder at heart an abolitionist. Although the men, and even the women, who suffered most would have been disposed to slay any one who suggested that they shared the opinions of the detested antislavery folk, nearly every one in his heart reprobated the institution and in his mind was revolving some scheme, generally fanciful, by which an end of it might be made. They were in the unhappy position where overwhelming self-interest fought with their moral sense. Now and then some one of them passed the critical point and entered into the fold of the accursed abolitionists; but others, after the manner of average men, paltered

with the situation, waiting for fate to decide the matter. In the meantime, they strove as best they could to lift these people to a higher estate.

In many ways the standard of care by which the conduct of a master in relation to his slaves was judged was high. He was expected to clothe them in a fit manner, keep them from the nocturnal wanderings, termed "running," so common a trait in these children of the tropics, to see that they were decently married, that they went to church in a dutiful way, and, above all, that they were not abused by other whites, particularly by other slaveholders. To strike or even to vilify the slaves of another was a very serious thing. The offended person knew well that it was his part to make his complaint to the servant's master. Where the negroes exceeded in number those needed for household and personal service—there were often a dozen or two thus employed in families of no great wealth—there was a division between the house people and the "hands." Those in the former group were selected folk, often belonging to families that had been associated with those of their [522] masters for a century or more. Such servants had rights that none could dispute. Not uncommonly their elders were the actual rulers of the establishment. These family slaves often received some little schooling, even when the laws forbade that slaves should be taught to read and write. The children of the household servants were allowed freely to play with those of their masters until the young people were about twelve years old. The boys of both often had their rough-and-tumble games together until they were young men. The field laborers, where the class was separate, had less perfect connection with their masters. They usually came to the family storeroom for the daily issued rations, which they received from the hands of the mistress or the daughter of the house. They were visited when sick, and their complaints were heard. They were free to all of the many festivities of the holiday time.

It is impossible to conceive of a more effective schooling for the African people than was given this adoption into the households, and often into the hearts, of high-minded masters. A like opportunity never before came and will never again come to so lowly a folk. The effect of this educative contact with the superior race is, as before noted, to be seen in the temper of the negroes during and after the civil war. Upon the high-minded master the effect of the institution was in many ways enlarging. A man is morally what his cares have made him, and of these the dutiful slaveholder has more than an average share. He grew in the power of command and in the habit of doing justice to many fellow-beings. He lived a large life. The qualities bred of his station have been of profit to his folk and time. All this is true of slavery of the domestic sort. It is not so in like manner of the great plantations which came with the development of the cotton and sugar industries. It was characteristic of the northern part of the South until it began to be the place of supply for the rapidly developing plantation district.

So long as the negro could look forward to life in the place and with the people of his birth his simple, careless nature opened to him little to bring a sense of danger. He was to live on until he passed in to the Elysium of the hereafter, of which he had no doubt whatever. Gradually there came, in the overcrowding of the farms and the diminishing fertility of the wasted land, the need of reducing the number of slaves. Then each year came the dreaded visits of the "trader," who was like a visible angel of death, to lead one or more into the far unknown country. Before the plantation demand for slaves began there were, of course, sales of slaves, but they commonly went as families, and not to places to them inconceivably remote. These could hope for Christmas reunions and [523] other exchanges, but when the negro was "sold South" the place and people that had known him would know him no more. My first impression of the iniquity of slavery came from the anxious questions of negroes as to the danger of their being sold to Alabama, that State being then the supposed destination of all those who were out of favor. They naturally strove to make interest with children whom they thought could successfully intercede for them.

There were several very diverse consequences arising from the exportation of slaves from the border States to the far South. It shook the confidence of the negro as to his safety in all that was dearest to him, and thus did much to degrade the relation between him and his master. It served, cruel as it was, to elevate the relatively uncivilized blacks of the more Southern districts, where

the newly imported laborers were mostly accumulated. It curiously operated to elevate the quality of the blacks in what was termed the slave-breeding States, those where the institution had longest been established. This was due to the selection of those of lower grade for the market. As it became necessary to part with slaves, a choice was naturally made of men and women who had least endeared themselves to the household. Save in rare cases, the trader sought rather the lusty youths for their brawn than the more delicate, refined house people. Moreover, where a fellow had shown a tendency to any vice, the choice fell on him. In this way for two or three generations a weeding process went on, with the result that the negroes who were left in the districts where the work was done acquired a quality noticeably better than those on the Southern plantations. The difference is almost that we would look for between two distinct races. The faces of the selected folk are more intelligent, the lines of their bodies finer, their moral and intellectual quality very much above those of their lower kindred. They are at their best, in very numerous instances, as gentle as the elect of our own race.

Where, as in the Southern plantations, the institution of slavery was deliberately made the basis of large commercial interests, the motives were wholly different from whatever existed in the early and better days, when the slaves were appendages of a household. Even on the largest tobacco plantations the numbers were not such as to exclude a share of contact with friendly whites. But on the great properties of the South the negro was not to any extent subject to the influences which had in the earlier stage of his apprenticeship done so much for him. Worked in gangs that were counted by the hundreds, seeing no whites except the overseers, they tended to lose what little culture they had gained. Their [524] peculiar but perfectly intelligible speech began a degradation into a puzzling jargon. African superstitions, little if any trace of which remained among their kindred in Virginia and Kentucky, regained their hold. Marriage and a respect therefor, which had been tolerably well affirmed, tended to disappear. All trace of good thus vanished from the system.

Although the great plantation, of the Mississippi type, was a relatively novel feature in American slaveholding, it was evidently the only largely profitable method of using slave labor. In the household system the care of the children, the aged, and the infirm, the unbusinesslike management of the labor, and the tendency to slipshod methods which with negroes can only be corrected by strict discipline, made ordinary farming unremunerative. It is evident that the profit, other than that in mere money, which the institution in the earlier state had brought to master and slave was rapidly diminishing, and that any further maintenance of it would have been calamitous. Though we may regret that it was ended by the civil war, it is difficult to see any other way in which it could have been terminated, or any profit which could have been gained by postponing the crisis.

MODERN CITY ROADWAYS.

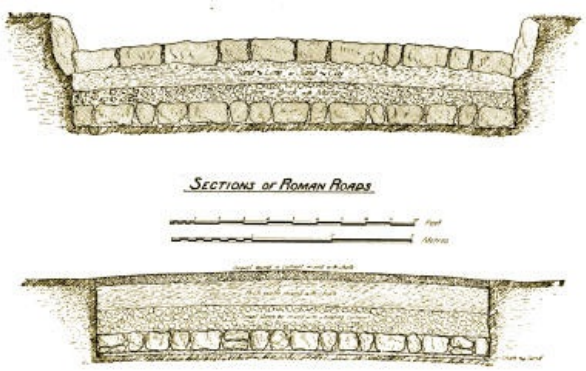
By NELSON P. LEWIS,
ENGINEER OF HIGHWAYS, BOROUGH OF BROOKLYN.

One of the conspicuous results of cheapened transportation and the facility with which the products of field, forest, mine, and factory can be transferred to the consumer has been the rapid increase in population of all our cities. In 1890 over forty-five per cent of the population of New York State (nearly six millions) was concentrated in four cities, while it is estimated that the greater city of New York contains at present not less and probably more than fifty per cent of the State's population. Nor is this tendency characteristic only of American cities, though the general impression seems to be that it is more conspicuous with us. In fact, many European cities (notably those of Germany) have outstripped ours in growth. In 1870 Berlin had about 150,000 less people than New York; in 1890 it had over 73,000 more. In 1875 Hamburg exceeded Boston in population by but 6,000, while in 1890 the German city was more than 121,000 ahead.

Meanwhile the rural population the world over has increased very slowly, or has positively decreased. The massing together of large numbers of people, without proper regard to sanitary conditions, has always resulted in great mortality, as witness the terrible plagues which have swept over the old cities of Europe, and the disastrous results during the summer of 1898 of concentrating large numbers of our volunteers in camps not subjected to rigid sanitary regulations. [525]

It has been amply demonstrated, however, that our cities can be made at least as healthful as the country districts, and an increasingly large number of engineers are engaged in such city building.

One branch of this municipal work will be considered in this paper—that of street improvement. The first impression gained by a stranger entering a city is undoubtedly that produced by the appearance of its streets. If they are poorly paved, irregular, dirty, and generally unkempt, he will consult his time table to see how soon he can get away. If they are broad, smooth, clean, well shaded and lighted, he will stay as long as possible.



In spite of the pride of the American people in the development of our cities, and notwithstanding the fact that their wealth enables them to have only the best, they have been slow to appreciate the value of thoroughly well-paved streets. As stated by Mr. Albert Shaw, European cities have been ahead of us in accepting the doctrine that "smooth and clean highways are a wise investment from every point of view, and that so long as the work is done in a thorough and scientific manner the result is worth having, regardless of cost. No city should think itself rich enough to prosper without them, and no city is so poor that it can not afford them if it has any reason whatever for continued existence. Good roadways are cheap at any cost, and bad ones are so disastrously expensive that only a very rich country, like the United States, can afford them." [526]

Space will not permit even a brief history of street paving, or an attempt to sketch its development, but reference will be made to the different kinds in general use, and the kind most in favor in various cities. Probably no one has introduced the subject of pavements

without reference to the Roman roads.

While Carthage was probably the first city to boast of paved streets, the Romans soon followed its example, and all over Europe, Asia, and Africa, as far as the domain of their emperors extended, they built with the greatest care and at enormous expense that magnificent system of roads which were often supposed, in the middle ages, to be of supernatural origin, and remain the wonder of our modern civilization. These roads were generally from four to six metres in width, and were constructed in this way: The roadbed was excavated; in it was placed a layer of stones, which were sometimes united with mortar. These stones were such as were most available, sometimes rounded stones similar to the cobblestones with which we are familiar, and in some cases in the Alps the foundation was a compact mass of angular stones, two feet or more in their longest dimension, carefully fitted together.

A Street in Pompeii, showing Old Roman Pavement.

On this foundation was placed a layer of plaster made of stone or brick pounded with mortar; then a course of sand and lime or sand and clay, leveled and pounded until very hard. The top or wearing surface was made of irregular flat stones, fitted together with nicety and united with cement. The total depth of these roads, or pavements, as they can properly be called, was from three to (in some cases) seven feet. It is said that in the province of Hispania alone (Spain and Portugal) twenty thousand miles of roads were built.

The first stone pavements to be laid in modern city streets were [527] those formed of stones in their natural condition, variously known as bowlders, pebbles, or cobblestones.

The first attempt at a street pavement in this country was doubtless that referred to by Mrs. John King Van Rensselaer, in the *Goede Vrouw of Mana-na-ta*, where she says, in speaking of what was once called Brower Street, because it passed by the great brewery built by one of the first of the Van Cortlandts: "This street lies between Whitehall and Broad, and was one of the first lanes laid out by the settlers, and was commonly known as 'The Road.' In 1657 it was paved with small round cobblestones, and the circumstance created such a sensation that the country people visited it as a curiosity, and it was one of the sights of the little dorp. The burghers laughingly nicknamed it Stone Street, which name it still retains. The improvement was effected by Madame Van Cortlandt, as she could not endure the dust that filled her tidy house, caused by the heavy brewers' wains that were constantly passing her door."

A Street in Naples, showing Large Paving Stones.

This cobblestone pavement, laid on Stone Street nearly two centuries and a half ago, has been a persistent type, and, on account of their availability and cheapness, such stones continued to be used in many cities until within a very few years. When they were well shaped and uniform in size they made quite a durable pavement, and, though rough and noisy, were capable, when well laid, of sustaining a considerable traffic. Fortunately, the better class of these stones are now so scarce and the poorer ones are so execrable that this type of pavement is becoming obsolete, though there are many miles for which more civilized pavements are yet to be substituted, two hundred and thirty-eight miles of which are unfortunately in the Borough of Brooklyn. The next step in advance was the use of stone shaped to uniform size, or approximately so, and with a more or less smooth surface. This is the pavement in most general use to-day, and for permanency and, consequently, cheapness can not be [528] surpassed. When first used, these blocks were quite large, and the size has been decreased until the best stone pavements laid at the present time in Great Britain are six-inch cubes, or still smaller,

with a surface four inches square and a depth of seven inches.

Cobblestone Pavement on Saratoga Avenue, Brooklyn.

But stone pavement when most carefully laid and maintained is noisy and unpleasant to ride over, and in these days we can never reconcile such a pavement with a handsome residence street. The writer experienced a distinct shock when on riding over Euclid Avenue, in Cleveland, last year, he found it still paved with Medina sandstone blocks, and it seemed that this famous street was still living on the reputation which Bayard Taylor gave it years ago as the handsomest street in the world.

In looking about for something more quiet and smooth than stone, the first material tried was wood. In London the first wood pavement was laid in the Old Bailey in 1839, and was soon followed by many others. None of these pavements lasted more than seven years, and, as they cost more than granite and were so short-lived, a prejudice arose against them, and as they wore out they were mostly replaced with granite. Since that time wood pavement has become popular again, and a large area is now covered with it. The material most generally in use is Baltic fir, though there is quite a large amount of Australian hard wood which is more durable. The people of London seem willing to bear the greater expense and submit to the annoyance of more frequent renewals for the sake of the quiet, and wood is certainly the least noisy of all known pavements.

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Paris had at the close of 1893 more wood than asphalt, the areas of pavements of different kinds being as follows:

Stone	7,541,258	sq. yds.,	71.5 per cent.
Wood	886,236	"	8.4 "
Asphalt	402,394	"	3.8 "
Gravel or macadam	1,724,632	"	16.3 "

Berlin also has some wood pavements, but asphalt seems more popular, though by far the greatest area is still of stone pavements.

Granite Pavement on Roadway of Brooklyn Bridge after Constant Use with Very Heavy Traffic for Sixteen Years.

The most durable wood pavements are those made of the hard woods of Australia, which are especially adapted to this purpose. They are mostly of the eucalyptus family, the red gum, blue gum, black butt, tallow-wood, and mahogany. Mr. George W. Bell, in a pamphlet published in 1895, gives some remarkable statistics as to the durability of these pavements. He cites the case of George Street, in Sydney, which sustains a very heavy traffic, and on which [530] a wooden-block pavement had been in constant use for over ten years, without repair of any kind. The only piece of wood pavement of this class which has been laid in this country, to the writer's knowledge, is on Twentieth Street, between Broadway and Fifth Avenue, in the Borough of Manhattan, where, in 1896, the Australian "kari" wood was laid. The work was done with the greatest care, and the resulting pavement has proved quite satisfactory. When Fifth Avenue was lately repaved the use of this material was considered, but, on account of the popular prejudice against all wood pavements and the delay which would be involved in obtaining the blocks, the idea was abandoned.

Looking North from Beverly Road and East Fifteenth Street, Brooklyn, in March, 1899.

Looking North from Beverly Road and East Fifteenth Street, Brooklyn, in October, 1899.

When wood pavements are spoken of in most of our cities, the taxpayer pictures to himself the round cedar block so generally in use in Western cities. These are used on account of their cheapness. They are usually laid on one or two courses of plank. The blocks are round, from four to eight inches in diameter and six inches in depth, are set as closely as possible to each other, and the joints are filled with gravel, after which they are usually poured full of pitch. Such a pavement, when new, is quite agreeable to ride over. It soon, however, becomes uneven; the defective blocks quickly decay; the surface not being impervious to water, the wet foundation under a pavement with so little rigidity becomes soft, and the mud or slime works its way up between the blocks, and the process of decomposition is expedited. We hear sometimes of the floating

pavements of Chicago. These are such cedar-block pavements which are said to rise with the floods of water filling the roadways after heavy rainfalls, and from specimens of the pavement which may be [531] seen in that city considerable sections must have floated away. The round block has nothing to recommend it but its cheapness, and this usually proves to be expensive economy. In Galveston, Texas, creosoted yellow pine blocks have been laid for some years with general satisfaction. They are laid directly on the fine sand, which is water-rammed so as to be very compact. The surface is formed with great care by a template to the exact grade and crown, and the joints are filled with similar fine sand. In Indianapolis creosoted blocks have been laid for several years, sixty thousand square yards having been put down during the past season. They are laid as closely as possible on a concrete foundation, with a sand cushion of one inch, and the joints filled with paving cement, composed of ten per cent of refined Trinidad asphalt and ninety per cent of coal-tar distillate, after which the surface is covered with half an inch of [532] clean coarse sand or granite screenings.

A New Cedar Block Pavement in Toronto.

Improved wood pavements are a luxury. They have many points of superiority over asphalt. They are so considered in London, where their use is continued, although they require renewal oftener than asphalt, and much more often than granite. They will undoubtedly be used more frequently in this country when the people are willing to pay the additional cost for the quiet and freedom from dust and from the somewhat disagreeable glare of asphalt.

For a dozen years or more brick has been used for street pavements in the cities of the middle West. The use of this material is by no means new. It began in Holland in the thirteenth century, and in the seventeenth century the highway from The Hague to Scheveningen was paved with brick. In Amsterdam such pavements are said to last from ten to twenty years, or an average of fourteen years. After about ten years they are commonly turned over and relaid, after which they will last about four years more. The size in common use is about the same as that made in this country.

A good paving brick should be tough enough to withstand the wear to which a street surface is subjected without chipping or cracking, and should not absorb more than from two to four per cent of its weight of water after submersion for forty-eight hours. It has not the wearing qualities of granite, although there is one block on Ninth Avenue, in the Borough of Manhattan, which has been subjected to very heavy traffic for eight years, has had no repairs to [533] speak of, and its condition to-day compares very favorably with almost any street pavement of equal age which has been subjected to similar traffic.

An Old Cedar Block Pavement.

Another kind of street improvement which must be considered is macadam. In small towns, and some quite large cities, most of the streets are improved in this way. When well maintained and kept smooth, but not too hard, it forms a most agreeable surface for driving. It should not, in the writer's judgment, be classed as a pavement at all, certainly not as a permanent one, and its use should be restricted to park drives and boulevards (for maintaining which liberal appropriations can be secured), and to suburban roads, where sewers and subsurface pipes have not yet been laid, and where temporary roads are required to furnish convenient communication between centers of population, and to assist in developing these districts.

Macadam has no place in a city street, nor is it wise to lay it on the entire width of a roadway. It best serves its purpose when laid in a comparatively narrow strip, leaving the sides of the road unimproved, except for the formation of earth gutters, so that the surface water can readily soak away where the soil is sufficiently porous.

Macadam is the most expensive of all street surfaces to keep in thoroughly good condition, and in this country it is rarely, if ever, so maintained, except in some of our park roads.

The pavement which is to-day, more generally than any other, superseding stone on all streets where the traffic is not excessive [534] nor the grades extreme, is asphalt. It is scarcely necessary to attempt to give a history of the use of this material, how its adaptability to paving purposes was first discovered by the improved condition of the roads over which it was hauled from the French mines for use in reservoir and tank linings, etc. The drippings from the carts were observed to have been compacted by travel until a smooth, hard roadway resulted. The first street to be paved with it was Rue Bergera, in Paris, in 1854, and it was so successful that in 1858 Rue St. Honore was similarly treated. An asphalt pavement was laid in Threadneedle Street, London, in May, 1869, and in Cheapside and Poultry in the fall of 1870, while in Berlin its use began in 1873.

Eighteenth Avenue, Brooklyn; Macadamized Full Width of Roadway and Gutters paved, with no Provision for Surface Drainage.

The laying of bituminous pavements in this country began in 1869, and they were first made of tar concrete, or Scrimshaw. Asphalt began to be used within the next year or two, and its popularity has been astonishing, as will be seen from the fact that

on January 1, 1898, the area of this kind of pavement laid in the United States was, as nearly as could be ascertained, thirty million square yards.

There is a notable difference between the European and American asphalts. The former may be called natural and the latter artificial pavements. In the former the material, as it comes from the mine, is ground to a powder, heated, placed upon the foundation prepared for it, and tamped into approximately the same condition [535] as before it was disturbed, though usually the product of several mines is mixed in order to obtain the best percentage of bitumen, but nothing is added to or taken from the bituminous rock. In the pavement usually laid in America, on the other hand, only a small proportion of the material is brought from the asphalt deposits, the principal part of it (sand) being obtained near at hand. In the one case the cost of long ocean or rail transportation has to be paid on the entire mass forming the pavement, while in the other this expense attaches to but from twelve to fifteen per cent of the material. This, of course, is a great advantage, and at recent prices it is scarcely possible for the European rock asphalts to compete with the artificial ones.

The making of a pavement from one of the standard asphalts may be briefly described as follows: The material as found in Nature has this composition:

Bitumen	38.14	per cent.
Organic matter, not bitumen	7.63	"
Mineral matter	26.38	"
Water	27.85	"
	100.00	

This is cooked until the water has been driven off, and some of the mineral matter has settled.

The above analysis is of Trinidad Pitch Lake asphalt, and is a particularly favorable result. This material is too hard for use in making a pavement, and it has to be softened or fluxed by the addition of something which will accomplish this purpose. In order to do this there is usually added to each one hundred pounds of refined asphalt about eighteen pounds of heavy petroleum oil. After this addition we have the asphaltic cement ready to combine with mineral matter, which is so selected that when asphaltic cement is added at the rate of about seventeen pounds of the cement to eighty-three pounds of the other all the particles will be coated, and more could not be added without making the pavement too soft. What is found to accomplish this best is fine stone dust and sand.

The asphaltic cement and sand are heated separately to about 300° F. The stone dust is then added to and mixed with the hot sand in the proportion of from five to eighty in the case of fine, well-graduated sand, to fifteen to sixty-seven for coarse sands, having less variation in size. The asphaltic cement is then added, and the materials are mixed to a homogeneous mass, which is ready to be taken to the street. It should reach there at a temperature not less than 250°, and is spread with hot iron rakes so as to give usually a thickness of two inches after consolidation. After spreading, it is rolled with a hand roller, after which a small amount of hydraulic [536] cement is swept over the surface, and it is thoroughly rolled with a steam roller of not less than ten tons, the rolling to be continued as long as the roller makes any impression on the surface.

The foundation is usually of cement concrete about six inches thick, though asphalt pavements are often laid over old stone pavements. Between the foundation and the wearing surface there is generally laid what is called a binder course, one inch thick and formed of small broken stone, to which has been added asphaltic cement, the same as is used in making the wearing surface. Five or six pints of this cement are used to each cubic foot of stone.

King's Highway, Brooklyn; Sixteen Feet in Center of Road Macadamized.

The pavement just described is made from Trinidad asphalt, the material from which nearly all the earlier artificial asphalt pavements in this country were made, and which was used almost exclusively until within the last half dozen years.

Within that time, however, it has been discovered that there are a number of other deposits of asphalt well adapted to use for street pavements. A very large deposit containing a high percentage of bitumen and very little mineral matter is located near the coast in the State of Bermudez, in Venezuela. Large deposits have been found in several places in California, and in Utah, Kentucky, and Texas, and a number of other places. The Kentucky product is classed as a natural rock asphalt, as it is a sandstone impregnated with bitumen. It has been mixed with about an equal portion of German rock asphalt and used with very satisfactory results in Buffalo. These asphalts are quite different in their composition, and [537] each requires somewhat different treatment. The Bermudez, being richer in bitumen and softer, requires the addition of very little flux. The California deposits furnish their own flux in a liquid asphalt or maltha, which is almost absolutely pure bitumen, and the use of petroleum residuum is thereby avoided altogether.

Asphalt Pavement on Clinton Avenue, Brooklyn.

It has been recognized since 1836 that the bitumen which forms the greater part of natural asphalts can be separated into two substances, which have been commonly known as petrolene and asphaltene, the former of which possesses the cementitious qualities essential to the making of a successful pavement. Instead of the arbitrary names—petrolene and asphaltene—these substances are sometimes more aptly designated as active and inert bitumen. It has been found that of the bitumen extracted from asphalts which have given the most satisfactory results in making street pavements, sixty-nine per cent or more is soluble in petroleum naphtha having a specific gravity of 72° Beaumé.

An asphalt pavement can not be economically kept in good [538] condition unless every defect which may develop is immediately

repaired. When the smooth, hard surface is once broken, disintegration proceeds very rapidly, and a large hole is soon formed. The more general distribution of smooth pavements, however, will tend to distribute the traffic more evenly, and the increasing use of rubber tires and rubber shoes for horses, to say nothing of the probably quite general use of motor vehicles, within the next decade will result in the elimination of the forces at present most destructive to pavements.

Much regret is often expressed that asphalt pavements should be so frequently opened for the purpose of laying or obtaining access to subsurface pipes and conduits, and thereby mutilated. As a matter of fact, there is no pavement at present in use which can be so effectively and satisfactorily restored as asphalt. When skillfully done, almost no trace of such an opening can be found.

The first question to arise, when it has been determined to pave a street, will be the selection of material, or the kind of pavement to be laid. In determining this, the governing considerations will be the traffic to be sustained, its density and character, the rate of grade, and the presence or absence of railroad tracks.

If the traffic be very heavy and the street given up wholly to business, ease of traction, durability, and economy of maintenance are of first importance, while quiet, comfortable riding, and beauty can be sacrificed to them. Many efforts have been made to determine the relative force required to draw a load over different kinds of surface under similar conditions. The following is from a table compiled by Mr. Rudolph Hering, from different authorities, the force being that necessary to move one ton on a level grade at a speed of three miles an hour:

Kind of Road.	Pounds.
Ordinary dirt road	224
Ordinary cobblestone	140
Good cobblestone	75
Common macadam	64
Very hard, smooth macadam	46
Good stone block	45
Best stone block (London)	36
Asphalt	17
Granite tramway	12½ to 13 ½
Iron railway	8 to 11 ½

The question of durability occurs next, and the different kinds of pavement which may be considered for city streets may be rated as follows, it being assumed that the traffic is not excessively heavy:

Kind of Pavement.	Life in years.
Best granite block on concrete	30
Granite block laid on sand	20
Belgian trap	20
Cobblestone	18
Asphalt	15
Best wood—rectangular block	10
Vitrified brick	12
Macadam	8
Cedar block—round—on sand	5

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No class of municipal work comes so near to the daily life of an urban population—both the business and the home life—as the surface improvement of city streets, and no expenditure is too great (provided the work is skillfully and honestly done) to make them smooth, clean, sanitary, and beautiful.

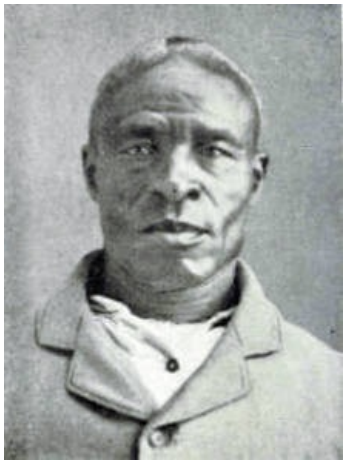
TYPICAL CRIMINALS.

By SAMUEL G. SMITH, LL. D.

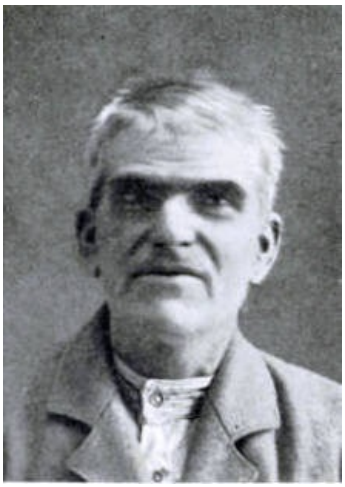
If the question of a criminal type, defined by certain marks of a physical nature and emphasized by accompanying mental and moral characteristics, were confined to the technical speculations of a special craft of scientists, the public would have little interest in the spread of the doctrines of Cesare Lombroso and his *confrères* in this country. When it is believed, however, that certain men and women are committed to prison or condemned to death not on account of crimes in any ethical sense, but because of spontaneous actions from vicious impulses beyond their control, the subject affects the administration of law, the theory of punishment, and the safety of society.

Lombroso and the Italian school say that they have discovered a type of man who is born a criminal, and who may be recognized by a Mongolian face, abnormal features, ill-shaped ears, unsymmetrical skull, and various psychical peculiarities, which are the result of bad organization. This doctrine is illustrated by descriptions of criminals who have the abnormalities, and in the hands of skillful writers the case is made very plausible. The theory is in harmony with so much popular modern thought, which loosely interprets the doctrine of evolution by a crass materialism, that it has infected American prison literature, while it has never misled those men to whom practical experience has given the most right to have an opinion on the subject. The sense of personal responsibility is still the foundation of social order, and if in truth there is no such thing, the world is awake at last from its dream of morality; righteousness is [540] resolved into heredity, structure, and habit; living is a mere puppet show, and the wreck of things impends. If Lombroso is right, modern scientific methods are sure to prove him so, and we shall have at last sound theories; but we shall have no world in which they can be used, for the dissolution predicted by Herbert Spencer will have come.

Group 1, No. 1.



Group 1, No. 2.



Group 1, No. 3.

Exceptional opportunities for the study of the abnormal classes in the institutions of this country and Europe have given me a personal interest in the question of the criminal type. I have discovered that the criminal anthropologists do not choose for comparison with the prison population their normal men from the ranks where the criminal classes are recruited. Blackwell's Island has no more peculiar inmates than abound in sections of New York near the East River; the residents of the Whitechapel district of London may be compared with the inmates of Pentonville, to the distinct credit of the latter; and the man in Roquette is no worse off in body than [541] scores whom I have seen in certain localities south of the Seine. The fact is, no human body exists which is not in some respects abnormal. The number of abnormalities and

their extent depend upon a variety of circumstances, among which are food, climate, occupation, and the incidents of birth itself, as well as the various forms of infantile disease. I will undertake to find enough physical peculiarities, in any locality, or among the members of any profession, to establish any physical theory which may be propounded.

Group 2, No. 1 (forger).

Group 2, No. 2.

Group 2, No. 3.

It occurred to me to try an experiment in a manner entirely different from the usual criminal researches. Having been very familiar with a certain prison for many years, I requested the warden, who is a very able man in his profession, to send me the photographs of ten or a dozen men whom he regarded as the most representative criminals in his population of some five hundred persons. The warden was not informed of the use I intended to make of the material, and supposed it was for illustration in university class work. Later, he gave me the Bertillon measurements of the men, with an epitome of their history. A number of these men I have known for years. So far from this selection supporting the modern theory of a criminal type, it confutes it in a conspicuous manner. The abnormalities are slight, and there is as great a diversity among the men as could be asked. It must be remembered that these cases were selected by a shrewd and competent official, solely upon their criminal record, and not in the interests of any theory whatever.

[542]

Of course, the men do not look well, but neither would any ordinary company of citizens if their heads were shaved and they were put in prison dress. I am always shocked by the changed appearance of the men after the prison transformation. Young embezzlers of elegant figure, who have moved in good society without a question, easily look the rascal behind prison walls.

The first group are murderers. No. 1 murdered his daughter because she insisted upon going to a party against his wishes. He has the head of a philosopher. It was his first crime. It may be noted that tattooing is supposed to be common among criminals. This man is tattooed, but committed no crime until fifty years of age, and was a deputy sheriff for some years. No. 2 did not kill his victim, but the assault was murderous, and the escape from death was accidental. It is difficult to discuss the negro in crime without entering into racial and social questions beyond the present limits. No. 3 has a very good head, an excellent ear, and, barring the expression, a pleasing face. He has a life sentence for murder. He is the worst man in the prison. I have for years believed him to be insane. His family is criminal. His father murdered his mother in a brutal manner before the child's eyes, when No. 3 was only eight years old. He himself has committed several desperate assaults, growing out of his persistent mania of persecution. No. 3 is not morally responsible, and there are usually two or three such prisoners out of a thousand subjects.

The second group are very diverse in structure and temperament, but have committed the same kind of crime. No. 1 is a

confidence man and a forger. He is a crafty and an habitual criminal, has served terms in various prisons, is keen of intellect, well educated, has traveled in many countries, and is a citizen of the world.

No. 2 is a confirmed forger, and has served several terms in prison for the same offense. He is a skillful bookkeeper, has an attractive manner, and as soon as he is out in the world secures employment and plans his next crime.

No. 3 is a counterfeiter. His head is small, but of excellent shape, and he has rather a refined physical organization. His criminal record is bad, and he has served at least one term before for the same offense. His imagination, temperament, and vices would select him as a person who would be guilty of a very different and more fleshly kind of crime. The group is formed by the correlation of crime; they have nothing in common in physical organization.

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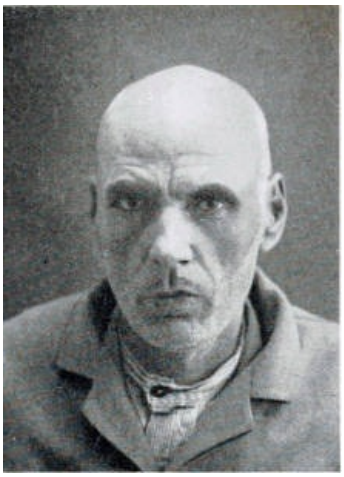

Group 3, No. 1.

Group 3, No. 2.

The third group are thieves. No. 1 is a confirmed criminal, and has served several terms in prison. He is the tallest man in the list. His head is "long" and well formed, and his features are regular. His expression indicates power of sustained thought, and his peculiar appearance is not due to his kind of crime, but to his habit of mind. He is a pessimist of the first rank, and hates the world, his fellow-men, and perhaps himself most of all. He will not work when at liberty, thinks that society is totally depraved, and that war upon it is the only proper mission in life. He is pre-eminently the antisocial man.

Group 3, No. 3.

[544]

No. 2 is really a pleasing fellow. He is tender, sympathetic, and pious. Under proper circumstances he might have made an admirable Sunday-school superintendent. He is plausible, insinuating, and winning. In temperament, feeling, and social habit he is the complete antithesis to No. 1. He is a most dangerous criminal, and has a black and varied record.

No. 3 is a man of lower grade of organization and habit, but he is a criminal by profession. He is an idle and worthless vagabond, but he is an accomplished thief. He makes an excellent prisoner, obedient to the rules, industrious, and seemingly anxious to improve. In fact, the prison furnishes his best environment, for it is only there that he is at peace with himself and his world.

The last two men presented are contrasts. No. 1 is an accidental criminal. His previous history and character give strong grounds for the belief that, under pressure of want for the necessaries of life, he was led astray by a man older and stronger than himself. It is not likely that he would repeat his fault. No. 2, on the other hand, is a sexual pervert of the worst kind, whose case seems so hopeless that perpetual imprisonment is indicated as the only relief for him, and the only safety for society. Apart from the expression of his eyes, caused by an irregular focus, there is nothing marked about the face. The head is of a pronounced "broad" type, but, on the other hand, he comes from a province of Germany where that type is dominant.

[545]

To complete the experiment, I submitted these portraits to a

number of

Contrasts, No. 1.

Contrasts, No. 2.

gentlemen, and to no two of them at the same time, for their opinions of the cases. The informal committee represented the different professions which might be expected to fit men for observation, for there was a lawyer, a physician, a railway president, a criminal judge, and a college professor. Each of them is eminent in his special field. The committee was manifestly handicapped by the shorn head, the prison dress, and the lack of the accessories of masculine ornamentation, such as collars and cravats. The committee was asked to name the crimes, and to group the men according to their criminal record. Each opinion differed from the other, and all were wide of the mark. The shrewd lawyer thought the accidental criminal "might be guilty of anything." It was only the college professor, the last man of the company from whom anything might properly be expected, who was able to select the worst two cases with the remark, "These men are degenerates." But while the committee was at work on the photographs the writer was at work on the committee, and actually discovered more anomalies of organization in these distinguished citizens than are apparent in the criminals. After this remark it is necessary to withhold their names, though some of them are men of national reputation.

It is time to reassert with increasing emphasis the personal responsibility of the individual, and to insist upon the enthronement and guidance of conscience. There are certainly social and economic reasons for crime, some of which the writer has pointed out elsewhere, but the chief fact in human life is the power of self-determination. The chief causes of crime, outside of personal and moral degradation, are psychical and not physical. The reader of history can not fail to have noted that relation of prevalent ideas to conduct which is so conspicuous in human affairs. The scenes of blood and desolation characteristic of the French Revolution are directly traceable to the doctrines which prepared the way for anarchy, but not for rational freedom.

We have had our attention directed to the contagion of suicide which has marked the last half decade. But Lecky tells us that suicide was made practically unknown in the civilized world by the spread of Christianity and its beliefs in the dignity and sanctity of man. The present contagion will disappear not as the result of food, or raiment, or houses, or any other material good, but by a revival of practical faith in the human soul and its capacity, in human righteousness and its obligation.

A CENTURY OF GEOLOGY.

By Prof. JOSEPH LE CONTE.

[*Concluded.*]

THE AGE OF THE EARTH.

Until almost the beginning of the present century the general belief in all Christian countries was that not only the earth and man, but the whole cosmos, began to exist about six thousand to seven thousand years ago; furthermore, that all was made at once without natural process, and have remained substantially unchanged ever since. This is the old doctrine of the supernatural origin and substantial permanency of the earth and its features. Among intelligent and especially scientific men this doctrine, even in the eighteenth century, began to be questioned, although not publicly; for in 1751 Buffon was compelled by the Sorbonne to retract certain views concerning the age of the earth, published in his Natural History in 1749.[1] Remnants of the old belief lingered even into the early part of the present century, and may even yet be found hiding away in some of the remote corners of civilized countries. But with the birth of geology, and especially through the work of Hutton in Scotland, Cuvier in France, and William Smith in England, the much greater—the inconceivably great—antiquity of the earth and the origin of its present forms, by gradual changes which are still going on, was generally acknowledged. Indeed, as already said, this is the fundamental idea of geology, without which it could not exist as a science.

Geology has its own measures of time—in eras, periods, epochs, ages, etc.—but it is natural and right that we should desire more accurate estimates by familiar standards. How old, then, is the earth, especially the inhabited earth, in years? Geologists have attempted to answer this question by estimates based on the rates of sedimentation and erosion, or else on the rate of changes of organic forms by struggle for life and survival of the fittest. Physicists have attempted to answer the same question by calculations based on known laws of dissipation of energy in a cooling body, such as the sun or the earth. The results of the two methods differ widely. The estimates of the geologists are enormous, and growing ever greater as the conditions of the problem are better understood. Nothing less than several hundred million years will serve his purpose. The estimates of the physicists are much more moderate, and apparently growing less with each revision. The latest results of King and Kelvin give only twenty to thirty millions.[2] This the geologist declares is absurdly inadequate. He can not work freely in so narrow a space—he has not elbow room.

The subject is still discussed very earnestly, but with little hope [547] of definite conclusion. One thing, however, must be remarked. Both parties assume—the geologist tacitly, the physicist avowedly—the nebular hypothesis of the origin of the solar system, and therefore the early incandescent *fluid* condition of the earth as the basis of all his reasonings. Now, while this is probably the most reasonable view, it is not so certain that it can be made the basis of complex mathematical calculation. There is a possible alternative theory—viz., the meteoric theory—which is coming more and more into favor. According to this view, the planets may have been formed by aggregation of meteoric swarms, and the heat of the earth produced by the collision of the meteors in the act of aggregation. According to the one view (the nebular), the heat is all primal, and the earth has been only losing heat all the time. According to the other, the aggregation and the heating are both gradual, and may have continued even since the earth was inhabited. According to the one, the spendthrift earth wasted nearly all its energy before it became habitable or even a crust was formed, and therefore the habitable period must be comparatively short. According to the other, the cooling and the heating, the expenditure and the income, were going on at the same time, and therefore the process may have lasted much longer.

The subject is much too complex to be discussed here. Suffice it to say that on this latter view not only the age of the earth, but many other fundamental problems of dynamical geology, would have to be recalculated. The solution of these great questions must

also be left to the next century. In the meantime we simply draw attention to two very recent papers on the subject—viz., that of Lord Kelvin,[3] and criticism of the same by Chamberlin.[4]

ANTIQUITY AND ORIGIN OF MAN.

Even after the great antiquity of the earth and its origin and development by a natural process were generally accepted, still man was believed, even by the most competent geologists, to have appeared only a few thousand years ago. The change from this old view took place in the last half of the present century—viz., about 1859—and, coming almost simultaneously with the publication of Darwin's Origin of Species, prepared the scientific mind for [548] entertaining, at least, the idea of man's origin by a natural process of evolution.

Evidences of the work of man—flint implements, associated with the bones of extinct animals and therefore showing much greater age than usually accepted—had been reported from time to time, notably those found in the river Somme by Boucher de Perthes. But the prejudice against such antiquity was so strong that geologists with one accord, and without examination, pooh-poohed all such evidence as incredible. It was Sir Joseph Prestwich who, in 1859, first examined them carefully, and published the proofs that convinced the geological world that early man was indeed contemporaneous with the extinct animals of the Quaternary period, and that the time must have been many times greater than usually allowed.[5]

Since that time confirmatory evidence has accumulated, and the earliest appearance of man has been pushed back first to the late glacial, then to the middle glacial, and finally, in Mr. Prestwich's Plateau Gravels, to the early glacial or possibly preglacial times.

Still, however, in every case earliest man was unmistakably man. No links connecting him with other anthropoids had been found. Very recently, however, have been found, by Du Bois, in Java, the skull, teeth, and thigh bone of what seems to be a veritable *missing* link, named by the discoverer *Pithecanthropus erectus*. The only question that seems to remain is whether it should be regarded as an ape more manlike than any known ape, or a man more apelike than any yet discovered. The age of this creature was either latest Pliocene or earliest Quaternary.

BREAKS IN THE GEOLOGICAL RECORD AND THEIR SIGNIFICANCE.

From the earliest times of geologic study there have been observed unconformities of the strata and corresponding changes in the fossil contents. Some of these unconformities are local and the changes of organic forms inconsiderable, but sometimes they are of wider extent and the changes of life system greater. In some cases the unconformity is universal or nearly so, and in such cases we find a complete and apparently sudden change in the fossil contents. It was these universal breaks that gave rise to the belief in the occurrence of violent catastrophes and corresponding wholesale exterminations and re-creations of faunas and floras.

It is evident, however, on a little reflection, that every such unconformity indicates a land period at the place observed, and therefore a time unrecorded in strata and fossils at that place—i. e., [549] a lost interval—certain leaves missing from the book of time. And if the unconformity be widespread, the lost interval is correspondingly great. It is therefore probable that change of species went on slowly and uniformly all the time, although not recorded at that place. Intermediate strata may be and often are found elsewhere, and the supposed lost interval filled. The record was continuous and the changes uniform, but the record is not all found in one place. The leaves of the book of Time are scattered here and there, and it is the duty of the geologist to gather and arrange them in proper order, so that the record may read continuously.

This is the uniformitarian view, and is undoubtedly far truer than the catastrophic. But the objection to it is that in the case of very widespread unconformities, such as occurred several times in the history of the earth, the changes of organisms are so great that if

the rate of change was uniform the lost interval must have been equal to all the rest of the history put together. Therefore we are compelled to admit that in the history of the earth there have been periods of comparative quiet (not fixedness) during which evolutionary changes were slow and regular, and periods of revolution during which the changes were much more rapid, but not catastrophic. This is exactly what we ought to expect on the idea of gradual evolution of earth forms by secular cooling, for in the gradual contraction of the earth there must come times of general readjustment of the crust to the shrinking nucleus. These readjustments would cause great changes in physical geography and climate, and corresponding rapid changes in organic forms. In addition to this, the changes in physical geography and climate would cause extensive migrations of species, and therefore minglings of faunas and floras, severer struggles of competing forms, and more rapid advance in the steps of evolution. Among these changes of organic forms there would arise and have arisen *new dominant types*, and these, in their turn, would compel new adjustment of relations and still further hasten the steps of evolution. Such changes, whether geographic, or climatic, or organic, would *not* be simultaneous all over the earth, but propagated from place to place, until quiet was re-established and a new period of comparative stability and prosperity commenced.

This view is a complete reconciliation of catastrophism and uniformitarianism, and is far more rational than either extreme.

Critical Periods in the History of the Earth.—Such periods of rapid change may well be called *critical periods or revolutions*. They are marked by several characteristics: (1) By widespread oscillations of the earth's crust, and therefore by almost universal unconformities. (2) By widespread changes of physical geography, [550] and therefore by great changes in climate. (3) By great and widespread changes in organic forms, produced partly by the physical changes and partly by the extensive migrations. (4) By the evolution of new dominant types, which are also the cause of extensive changes in species. (5) Among the physical changes occurring at these times is the formation of great mountain ranges. The names of these critical periods or revolutions are often taken from the mountain range which form their most conspicuous features.

There have been at least four of these critical periods, or periods of greatest change: (1) The pre-Cambrian or Laurentide revolution; (2) the post-Paleozoic or Appalachian; (3) the post-Cretaceous or Rocky Mountain; (4) the post-Tertiary or glacial revolution.

Now, as these critical periods separate the primary divisions of time—the eras—it follows that the *Present*—the Age of Man—is an era. It may be called the *Psychozoic Era*. These views have been mainly advocated by the writer of this sketch, but I believe that, with perhaps some modification in statement, they would be accepted by most geologists as a permanent acquisition of science. [6]

GEOLOGICAL CLIMATES.

Attention was first drawn to this subject by the apparently unique phenomena of the Glacial epoch.

For nearly a century past Alpine glaciers, their structure, their mysterious motion, and their characteristic erosive effects, have excited the keenest interest of scientific men. But until about 1840 the interest was purely physical. It was Louis Agassiz who first recognized ice as a great *geological agent*. He had long been familiar with the characteristic marks of glacial action, and with the fact that Alpine glaciers were far more extensive formerly than now, and had, moreover, conceived the idea of a Glacial epoch—an ice age in the history of the earth. With this idea in his mind, in 1840 he visited England, and found the marks of glaciers all over the higher regions of England and Scotland. He boldly announced that the whole of northern Europe was once covered with a universal ice sheet. A few years later he came to the United States, and found the tracks of glaciers everywhere, and again astonished the world by asserting that the whole northern part of the North American continent was modeled by a moving ice sheet. This idea has been confirmed by all subsequent investigation, especially here in

America.

But it would be strange, indeed, if the cold of the Glacial epoch should be absolutely unique. Attention was soon called to similar marks in rocks of other geological periods, especially in the Permian of the southern hemisphere. This opened up the general question of *geological climates and their causes*. [551]

Perhaps no subject connected with the physics of the earth is more obscure and difficult than this. The facts, as far as we know them, are briefly as follows: (1) All the evidence we have point to a high, even an ultra-tropical, climate in early geological times; (2) all the evidence points to a uniform distribution of this early high temperature, so that the zonal arrangement of temperatures, such as characterizes present climates, did not then exist; (3) temperature zones were apparently first introduced in the late Mesozoic (Cretaceous) or early Tertiary times, and during the Tertiary the colder zones were successively added, until at the end there was formed a polar ice-cap as now.

Thus far all might be explained by progressive cooling of the earth and progressive clearing of the atmosphere of its excess CO_2 and aqueous vapor. But (4) from time to time (i. e., at critical periods) there occurred great oscillations of temperature, the last and probably the greatest of these being the Glacial period. The cause of these great oscillations of temperature, and especially the cause of the glacial climate, is one of the most interesting and yet one of the obscurest and therefore one of most hotly disputed points in geology. Indeed, the subject has entered into the region of almost profitless discussion. We must wait for further light and for another century. Only one remark seems called for here. It is in accordance with a true scientific method that we should exhaust terrestrial causes before we resort to cosmical. The most usual terrestrial cause invoked is the oscillation of the earth's crust. But recently Chamberlin, in a most suggestive paper,[7] has invoked oscillations in the composition of the atmosphere, especially in its proportion of CO_2, as the *immediate* cause, although this in turn is due to oscillations of the earth's crust.

[552]

THE NEW GEOLOGY.

Heretofore the geological history of the earth has been studied only in the record of stratified rocks and their contained fossils. But in every place there have been land-periods in which, of course, erosion took the place of sedimentation. This kind of record is very imperfect, because there are no fossils. Until recently no account was taken of these erosion-periods except as breaks of indefinite length in the record—as lost intervals. But now, and mainly through the work of American geologists, interpretation of these erosion-periods has fairly commenced, and so important has this new departure in the study of geology seemed to some that it has been hailed as a new era in geology, connecting it more closely with geography. Heretofore *former* land periods were recognized by unconformities and the amount of time by the degree of change in the fossils, but now the amount of time is estimated in *existing* land surfaces by topographic *forms* alone. This idea was introduced into geology by Major J. W. Powell, and has been applied with success by William Morris Davis, W. J. McGee, and others.

The principle is this: Land surface subject to erosion and standing still is finally cut down to gently sweeping curves, with low, rounded divides and broad, shallow troughs. Such a surface is called by Davis a Peneplain. Such a peneplain is characteristic of old topography. If such a surface be again lifted to higher level, the rivers again dissect it by ravines, which are deep and narrow in proportion to the amount and rate of the uplift. If the land again remains steady, the sharply dissected surface is again slowly smoothed out to the gentle curves of a peneplain. If, on the contrary, the surface be depressed, the rivers fill up the channels with sediment which, on re-elevation, is again dissected. Thus the whole *ontogeny* of land surfaces have been studied out, so that their age may be recognized at sight.

Thus, while heretofore the more recent movements of the crust were supposed to be readable only on coast lines and by means of the old sea strands, now we read with equal ease the movements of the interior by means of the physiognomy of the topography, and

especially the structure of the river channels. Moreover, while heretofore the history of the earth was supposed to be recorded only in stratified rock and their contained fossils, now we find that recent history is recorded and may be read also in the general topography of the land surfaces. Geography is studied no longer as mere description of earth forms, but also as to the causes of these forms, no longer as to present forms, but also as to the history of their becoming. Thus geography, by its alliance with geology, has become a truly scientific study, and as such is now introduced into the colleges and universities. It is this alliance with geology which has caused the dry bones of geographic facts to live. It is this which has created a soul under the dry "*ribs of this death*." This mode of study of the history of the earth has just commenced. How much will come of it is yet to be shown in the next century.

In this connection it is interesting to trace the effect of [553] environment on geological reasonings in different countries. Heretofore, especially in England, what we have called peneplains were usually attributed to marine denudation—i. e., to cutting back of a coast line by constant action of the waves, leaving behind a level submarine plateau, which is afterward raised above sea level and dissected by rivers. American geologists, on the contrary, are apt to regard such level surfaces as the final result of aërial degradation or a base level of rain and river erosion. The same difference is seen in the interpretation of glacial phenomena. Until recently, English geologists were inclined to attribute more to iceberg, Americans more to land ice. Again, in England coast scenery is apt to be attributed mainly to the ravages of the sea, while in America we attribute more to land erosion combined with subsidence of the coast line. In a word, in the tight little sea-girt island of Great Britain, where the ravages of the sea are yearly making such serious inroads upon the area of the land, it is natural that the power of the sea should strongly affect the imagination and impress itself on geological theories, and tend perhaps to exaggeration of sea agencies, while the broad features of the American continent and the evidences of prodigious erosion in comparatively recent geological time tend to the exaggeration of erosive agency of rain and rivers. These two must be duly weighed and each given its right proportion in the work of earth sculpture.

PALEONTOLOGY.

Paleontology at first attracted attention mainly by the new and strange life forms which it revealed. It is the interest of a zoölogical garden. This interest is of course perennial, but can hardly be called scientific. Geology at first was a kind of wonder book.

Next fossils, especially marine shells, were studied as characteristic forms denoting strata of a particular age. They were coins by which we identify certain periods of history. They were "medals of creation." It was in this way chiefly that William Smith, the founder of English stratigraphic geology, used them. It was in this way that Lyell and all the older geologists, until the advent of evolution, were chiefly interested in them.

It was Cuvier, the great zoölogist and comparative anatomist, who, in the beginning of the present century, first studied fossils, especially mammalian fossils, from the *zoölogical* point of view—i. e., as to their affinities with existing animals. Cuvier's studies of the vertebrates of the Paris basin may be said to have laid the foundation of scientific paleontology from this point of view.

Thenceforward two views of paleontology and two modes of [554] study gradually differentiated from one another, the one zoölogical, the other geological. In the one case we study fossils in *taxonomic* groups—i. e., as species, genera, families, orders, etc.—and trace the gradual evolution of each of these from generalized forms to their specialized outcomes, completing as far as possible the genetic chain through all time. In the other we study fossils in *faunal groups*, as successive geological faunas, and the geographic diversity in each geological period—i. e., the evolution of geologic faunas and the causes of geographic diversity in each. In a word, we study the laws of distribution of faunas in time geologically and in space geographically, and the causes of these laws in each case. The first is strictly a branch of zoölogy and botany, and we leave it to these specialists. The second alone belongs properly to geology. In this purely geologic paleontology, as seen from its scope given

above, there are many questions of widest philosophical interest which are only now attracting the attention they deserve. I only touch lightly two which have been brought forward in these very last years of the century.

I. General Laws of Faunal Evolution.—The evolution of the organic kingdom from this strictly geological point of view may be briefly formulated as follows:

1. Throughout all geological time there has been a general movement upward and onward, as it were abreast, everywhere. If this were all, there would be only geological progress, but no geographical diversity. Geological history would be the same everywhere. A time horizon would be easily determined by identity of fossil species. This we know is not true. Therefore there are other elements besides this.

2. In different countries, isolated from one another and under different conditions, evolution takes different *directions* and different *rates*, producing geographical diversity in each geological period. This diversity increases with time as long as the isolation continues. If this were all, the geographical diversity by continued divergence would have become so great that it would be impossible even approximately to determine any geological horizon. The history of each country must be studied for itself. A general history of the earth would be impossible. But this also is not true. There is therefore still another element.

3. From time to time, at long intervals—i. e., *critical periods*—there are widespread readjustments of the crust to internal strain, determining changes of physical geography and of climate, and therefore wide migrations of species with mingling and conflict of faunas. This would produce more rapid movement of evolution, but [555] at the same time more or less complete obliteration of geographical diversity.

4. After these periods of migrations and minglings there would be re-isolations in new localities, and the process of diversification would recommence and increase as long as the isolation continues.

The last of these critical periods of migrations and minglings and struggles for life among competing species was the *Glacial epoch* or ice age. Therefore the present geographical distribution of species was largely determined by the extensive migrations of that time.

II. Cosmopolitan and Provincial Faunas.—There are apparently in the history of the earth periods of widespread or cosmopolitan faunas, alternating with localized or provincial faunas. The cosmopolitan periods are usually times of prevalence of limestones or organic sediments, and the fossils are very abundant. The provincial periods are usually characterized by sandstones and shales or mechanical sediments, and are comparatively poor in fossils. Moreover, it is believed that the cosmopolitan limestone periods are oceanic periods—i. e., periods of wide oceans and lower and smaller continents and little erosive activity, while the sandstone periods, characterized by provincial faunas, are periods of higher and larger continents, and therefore of great erosion and abundant mechanical sedimentation.

Now, according to Chamberlin, these remarkable alternations are due to oscillations of the crust, in which the continents are alternately lifted and depressed. It must be remembered that abyssal faunas are almost unknown among fossils. This is the necessary result of substantial permanency of oceanic basins. The whole geological record is in shallow-water faunas. These shallow waters are along continental shore lines and in interior continental seas. According to Chamberlin again, during a period of continental depression all the flat continental margins are submerged, forming broad submarine platforms, and the lower interior portions of the continents are also submerged, forming wide and shallow interior seas. Under these conditions continental waste, and therefore sand and clay sediments, are reduced to a minimum. Life, animal and vegetal, abounds, and therefore much limestone is formed. The oceans are widely connected with one another, and therefore the faunas are widespread or cosmopolitan. During the period of elevation, on the contrary, the continents are extended to the margin of the deep oceanic basins, the broad, shallow submarine platforms are abolished, the interior seas are also abolished, the shallow-water areas are reduced to isolated bays, and their faunas are peculiar or provincial. Also, elevated and enlarged continents [556] give rise to maximum erosion, and therefore abundant sediments of

sandstone and clay, and comparative poverty of life and therefore of limestone. Chamberlin also gives reasons why the oceanic periods should be warm, humid, equable in temperature, and the atmosphere highly charged with CO_2, and therefore highly favorable to abundant life, both vegetal and animal, while land periods would be drier and cooler, the atmosphere deficient in CO_2, and therefore cold from that cause and in many ways unfavorable to abundant life.

These extremely interesting views, however, must be regarded as still on trial, as a provisional hypothesis to be sifted, confirmed, or rejected, or in any case modified, in the next century.

Lastly, it is interesting to note the ever-increasing part taken by American geologists in the advance of this science. There has been through the century a gradual movement of what might be called the center of gravity of geological research westward, until now, at its end, the most productive activity is here in America. This is not due to any superiority of American geologists, but to the superiority of their opportunities. Dana has well said that *America is the type continent of the world*. All geological problems are expressed here with a clearness and a simplicity not found elsewhere. We must add to this the comparative recency of geological study in this rich field. In Europe the simpler and broader problems are already worked out, and all that remain are difficult problems requiring much time. In America, on the contrary, not only are all problems expressed in simpler terms, but many great and broad problems are still awaiting solution. For these reasons the greatest activity in research, and the most rapid advance during the next century, will probably be here in America.

"SALAMANDERS" AND "SALAMANDER" CATS.

By NORMAN ROBINSON.

In many places in the extreme Southern States, especially in what is locally known as the "piney woods," one of the most notable features is the constantly recurring mounds of yellow sand which everywhere dot and, it must be confessed, disfigure the monotonous landscape. These piles of earth are usually nearly circular in form, fairly symmetrical in contour, from six inches to two feet in diameter, and, save where they have been beaten down by rain or winds or the trampling of cattle, about half as high as they are broad. Often these sand heaps are pretty evenly distributed, sometimes so thickly as to cover at least one fourth of the soil surface. If you ask a native the [557] cause of this singular phenomenon, which you will perhaps at first be disposed to consider a kind of arenaceous eruption which has somehow broken out on the face of Nature, your informant will sententiously reply, "Salamanders!"

All this disfigurement is indeed the work of a curious little rodent popularly so named and about the size and color of an ordinary rat. He is never seen above ground if he can possibly help it. He digs innumerable branching underground tunnels at depths varying from one to six feet, and these mounds of sand are simply the "dump heaps" which, in his engineering operations, he finds it necessary to make.

"Snap-shot" View of a Live "Salamander."

After carrying the excavated earth to the surface this cautious little miner takes the greatest pains to cover up his tracks. No opening into his burrow is left. How he manages to so carefully smooth over his little sand mound and then literally "pull the hole in after him" is as yet unexplained. The work is mostly done at night, when observation is especially difficult. Sometimes, when he is a little belated and the early morning twilight admonishes him that it is "quitting time," he gets in a hurry and slights his work. Then a little depression at the top of the mound tells where he has made a hasty exit. Ordinarily the rounding out of the sand pile is as deftly done as though it had all been managed from above. Indeed, the feat actually accomplished by this little underground builder appears more puzzling the more it is considered. The most skilled human engineer would confess his inability to thus pile up a mound [558] of loose sand, go down through it, leave the top perfectly smoothed over, and, with no supports save the sand itself, to so fill up the passageway above him as he went down that not the slightest mark should be left to indicate his pathway of retreat.

Even if you dig into and under one of these sand mounds you will find very little to betray the builder's whereabouts. It is seemingly all solid earth, and unless you know exactly when and where and how to dig you will probably give up the search in disgust, with your labor and your backache but no "salamander" hole for your pains. Indeed, the cunning of this little rodent in hiding his burrow is quite as conspicuous as his skill in digging it. "Strategy" is his strong point. If by any chance you come upon his burrow it is probably an old abandoned one that is closed up and leads nowhere. The chances are ten to one that his real burrow is rods if not furlongs away.

Provided you can find the last mound he has built and not more

than four or five hours have elapsed since its completion, by digging diagonally to the right or left, at the distance of a foot or so, you will have a fair chance of encountering his burrow. He is probably near by, resting from the severe labors of the previous night. If you give him time to get his nap out and finish his job, your wiser plan will be to stop hunting and digging a little before you begin.

Why this little underground dweller should be called "salamander" is one of those mysteries of popular nomenclature which is seemingly inexplicable. There is certainly nothing in the habits or appearance of the animal to suggest the fabled fireproof batrachian. Like some other lovers of darkness, he has quite a number of *aliases* by which in various portions of the South and West he is known. "Gopher," "pouched rat," "hamster," and "muelos" are some of the titles by which he is locally known. "Salamander" appears to be the most generally accepted one.

This enterprising little rodent belongs to an ancient if not honorable family. By naturalists he is generally known as "pocket gopher," and is classed among the *Geomyidæ*. Some fifteen known species have been recognized, with possibly more to hear from, and with a habitat extending quite across the continent. The Florida species is probably *Geomys tuza* (Ord.), and though not as large as one or two others, is quite the peer of any of his cousins in enterprise and ability to look out for himself.

The illustration given is from what is probably the only photograph of a living "salamander" ever taken. Mr. Geomys is not a model "sitter." No unwilling candidate for the "rogues' gallery" has [559] more decided views on the subject of having his picture taken. In a general way, it may be said that he doesn't pose for anybody. Precisely how this prejudice was finally overcome it is needless to state. Perseverance and "snap shots" were too much for our recalcitrant rodent. In the matter of "looking pleasant" it must be conceded that Mr. Geomys was a little intractable.

"Dump Heaps" of the "Salamander."

The fore legs and feet of the "salamander" are worth studying. They remind one somewhat of those of the mole, but are more stoutly built, with much longer claws, and are evidently designed for harder tasks. They are controlled by powerful brachial and pectoral muscles, and, as we shall see, are not only special tools adapted to special and difficult work, but work which requires an enormous expenditure of physical force.

The engineering problems which this little troglodyte has to solve are far and away ahead of any that the New York Rapid-Transit Commission has to deal with. It is very much as though a single miner were placed over in Hoboken, a hundred feet below the surface, with instructions to tunnel under the Hudson River with no [560] tools except his hands, without a chance of seeing daylight until he reached it on the New York side, and with the added conditions that all the excavated earth should be carried out at the eastern opening of the tunnel, and finally that he should obliterate all marks of his work and, as he retreated into his tunnel, pack the exit shaft above

him so tightly and so deftly that it is impossible to trace its course!

How our little fur-coated engineer solves all these problems is as yet a mystery. We only know that he does it. He has a steam engine in his shoulders and shovels for hands, but his exact methods of using them is as yet largely a matter of conjecture. Only two plans of operation would seem to be possible. One would be for the "salamander" to first carry the excavated earth all to the rear into some portion of his already finished tunnel, and finally, when the outward exit is completed, to carry it back again and deposit it on the surface. This, of course, involves a double transfer of all the earth removed. It is more likely that the "salamander" first forces a narrow passageway along the line of his future tunnel in a way similar to that pursued by the mole. The latter animal has the advantage of working near the surface, and the earth always yields along the line of least resistance, which of course is upward. Four or five feet down there is no such line, and the amount of force required to push the ground aside must be something enormous. When the "salamander" comes to the upper air the work of excavation and enlargement begins. He then piles upon the surface all the earth that he can not use in obliterating his upward passageway. As the writer has frequently observed fresh sand mounds hundreds of feet from any others, he is inclined to believe that this is the real method pursued.

The exceeding care which the "salamander" takes to leave no opening into his subterranean home arises, no doubt, from his horror of snakes. In this respect no woman can surpass him. His antipathies to reptiles are probably the accumulated embodiment of hundreds of centuries of ancestral experience. He is aware that these hereditary enemies of his race are of a very investigating turn of mind, and put in a good deal of spare time when awake in crawling into and exploring any tempting hole they may discover. And so Mr. Geomys, like the sensible fellow that he is, not only takes good care to shut and lock his front gate every time he is compelled to go through it, but he blocks up the whole passageway and does his best to convince trespassers that it is all a mistake to suppose that there ever has been any roadway leading to his underground home.

Indeed, it is by taking advantage of this morbid antipathy to [561] intruders and daylight that our little underground dweller is usually caught. If by skillful digging a recently formed burrow is reached, one may be reasonably certain that in from five to ten minutes Mr. "Salamander" will be on hand to see what has happened and to repair damages. A shotgun kept steadily aimed at the opening, and with a quick pull on the trigger the instant the slightest movement in the sand is seen, "fetches" him every time. Another very successful method is to place a strong trap right at the opening into his burrow. In making repairs our "salamander" is in too big a hurry to look very carefully where he steps, and so is quite likely to blunder into the trap. He is always caught, however, by one of his legs, and if left any length of time is quite apt to gnaw off the captive limb and thus make his escape. Spartan bravery or love of freedom surpassing this would be hard to find.

The food of *Geomys bursarius* appears to be exclusively vegetable. Native roots and root stocks, cones and bulbs, together with the root bark of various trees, are eaten by him, and sometimes in a very annoying way. Orange trees are peculiarly liable to his attacks. He gnaws through and around the tap root as near to the surface as he can without disturbing it or in any way calling attention to his work, and not infrequently he continues his depredations until every root of any size is eaten off. This, of course, means the death of the tree.

From the "salamander" point of view, however, the greatest food "bonanza" of all is a sweet-potato patch. "A 'possum up a 'simmon tree" or a "pig in clover" is not more alive to the delights and advantages of the situation. He not only eats all he can stuff, but invites his relatives and friends. Nor is this all. He has learned that in autumn sweet potatoes are liable to suddenly disappear, so he "takes time"—and the potatoes—"by the forelock," and packs them away in liberal measure in his burrow for winter use. So well understood are the ways and weaknesses of this underground marauder that any suspicious mound of earth in a sweet-potato field is the signal for an active campaign of extermination, which ends only in the intruder's flight or death.

The "side pockets" of the "salamander" have already been

referred to. They are undoubtedly a great convenience to their owner in carrying food and possibly other things. The capacity of these cheek pouches is about sufficient to give room for a pigeon's egg. They are, however, quite extensile, and can readily be made to hold three or four times this amount. Indeed, the skin and underlying connective tissue are so elastic that these pockets can [562] readily be turned inside out. It is claimed that the "salamander" employs his handlike fore feet to fill and empty these receptacles, using the right foot for the left pouch, and *vice versa*. A gentleman in Florida recently assured me that by a lucky thrust of a spade he once killed one of these mischievous rodents as he was in the very act of cutting off the roots of an orange tree. The cheek pouches of the culprit were filled with fragments of bark which he had gnawed off, doubtless to be stowed away in his burrow.

Why, in a climate where there is almost no winter, where there is very little interruption to vegetable growth and the food supply is practically unlimited, provisions should thus be stored away is somewhat difficult to explain. It is not impossible that it is simply the survival of an ancestral habit acquired during the Glacial period. Or it may be that, like the dog, the "salamander" finds the flavor of old and well-seasoned food more to his taste. All that can be positively affirmed is that this wise little rodent does, occasionally at least, thus *caché* his food supplies.

One of the most curious results of the existence and habits of this elusive little burrowing rodent is the development of a new and peculiar breed of *Felis domestica*, called "salamander" cats. Ordinary tabbys do not understand or admire the ways of *Geomys bursarius*, or, for some other good and sufficient feline reason, do not include him in their game list. The variety of cats in question, which, so far as the author knows, is confined to Florida, appears to have been developed spontaneously and with very little if any human agency, and is noted for its special skill in catching "salamanders," as well as a decided liking for the sport. Any Mrs. Tabby of this breed, especially if she has a family to provide for, is up betimes in the morning. The particular object of her pursuit is a remarkably early riser, and finishes his day's work before most people have begun theirs. So if there is a convenient fence around the grounds she proposes to hunt she mounts it with the first peep of day, and, with a sharp eye to landward, starts on her tour of observation. Any fresh pile of sand is closely scrutinized. The slightest movement there brings her to the mound with a spring, and she is at once crouching behind it; so when Mr. Geomys comes up in a big hurry with his next load of sand he finds somebody to meet him that is in a bigger hurry still, and so the unsuspecting victim is borne off in triumph.

An estimable lady of the writer's acquaintance who owned one of these "salamander" cats, with a single juvenile pussy to provide for, kept an accurate account of the number of these rodents which she saw this industrious mother cat bring to her offspring in a single month. The number was thirty, and as the month happened to be [563] February this gave, of course, two more than a "salamander" a day.

One other curious observed feature of this new variety of cats is their want of fecundity. The mother tabby seldom has more than one kitten at a birth. The writer once owned a fine female of this breed that scrupulously adhered to the traditional habits of her race.

This particular pussy, like the rest of us, had her family troubles. Her one kitten—probably from its mixed parentage—was always inclined to rebel at the "salamander" diet. There was something amusing to a degree and suggestively human in the old cat's methods of discipline. When she had succeeded in catching a salamander she would always first bring it and lay it down before her mistress, to make sure of the praise and the petting. Then, with a motherly "*meow*," she would call her kitten. That frisky little youngster was always quite ready for his breakfast, but showed a decided preference for the "maternal font." Then the old cat would give him a "cuff" that would send him spinning. Then she would take up the "salamander" and put it down before her hopeful offspring with an air that said as plainly as words could do: "There, now! Eat that or go hungry!" Then her mother love would get the better of her and she would go to licking and petting her disobedient baby, and it would usually end in the kitten's having its own way and satisfying its hunger with milk from the "original package." By persistence and the force of example the old cat finally succeeded in accustoming her offspring to what she evidently thought the

orthodox diet of her race.

The writer is quite well aware of the intrinsic difficulties involved in the spontaneous development of any new variety of cats. Still, such branching of types has occurred in the past, and of course is possible now. When his attention was first called to the matter he was inclined to consider it merely an instance of animal education. A fact that came under his personal observation seems, however, hard to reconcile with this or any theory that does not concede the hereditary transmission of acquired habits and tastes.

A kitten of the breed of cats in question was taken when very young and reared nearly a mile away from its mother. When grown it developed the same skill in hunting "salamanders," and the same love for the sport as that for which its mother was celebrated.

Dogs, of course, have long been noted for the readiness with which acquired knowledge, habits, and tastes manifest and perpetuate themselves in hereditary forms. The setter, pointer, collie, St. Bernard, and other well-known breeds will occur to [564] everyone as illustrating this psychic plasticity. Doubtless the cat brain is somewhat less impressible, but there would seem to be good reasons for including it among the educably variable types.

WHAT MAKES THE TROLLEY CAR GO.

By WILLIAM BAXTER, Jr., C. E.

III.

Note.—Figs. 28 and 32 are reproductions of photographs kindly furnished by the General Electric Company, while for the view of car, Fig. 30, we are indebted to Colonel N. H. Heft, chief electrical engineer of the New York, New Haven, and Hartford Railroad.

Although the electric railway has been introduced throughout the civilized world with the most remarkable rapidity, replacing cable as well as horse roads, there has always been a strong opposition to the use of the overhead trolley, and in some places, as, for instance, the city of New York, this opposition has been so strong as to prevent the introduction of the system until some other means of conveying the current to the moving cars was devised. Many attempts have been made to solve this problem, and the patents taken out on such devices can be numbered by the hundred and possibly by the thousand. Inventors in this field, however, have not met with all the encouragement they could desire, owing to the fact that, notwithstanding opposition, the overhead trolley has been permitted in all but about three or four of the larger cities of this country, and the greater portion of those of other countries. The principal well-founded objection that can be raised against the trolley is that it is unsightly and destroys the appearance of the street, but those who are opposed to it also claim that it is dangerous, and that underground or surface systems would not be. As a matter of fact it is not dangerous, and there is nothing on record to show that it is. Many persons have been run over by trolley cars, but this is no fault of the overhead trolley; it is due to the fact that street railroads are permitted to run cars through crowded streets at a speed that is too great for safety. Underground conduit cars running at the same speed would run over just as many people. In accusing the trolley of being dangerous it is sought to prove that the current flowing in the wire can do harm; but the history of the numerous roads in existence shows that, so far as human beings are concerned, the trolley current is not fatal, although it can give a decidedly unpleasant shock, such as one would not care to experience the second time. There is just as great, if not greater, liability of obtaining shocks from underground systems as from the trolley, therefore the only real gain that can be made by their use is in the artistic sense. From a financial point of view no underground system so far devised can compare with the overhead trolley; but if any one should devise anything hereafter that can be constructed at the same expense and will not cost more for maintenance it will undoubtedly find an extensive application. Until such a perfect solution of the problem makes its appearance the field for these devices will be confined to cities like New York and Washington, where the overhead trolley is not permitted.

Every system of conductors that dispenses with the overhead wire is called by the layman an underground trolley, but, properly speaking, these systems may be divided into surface and subsurface conductors. Both of these may again be divided into exposed and inclosed conductors, and also into continuous and sectional conductors. Finally, we may designate the various modifications as mechanical, electrical, and magnetic, the mechanical being those that accomplish the result by purely mechanical means, the electrical being those that employ electrical devices, and the magnetic those that depend for their action upon the attraction of magnets. The principal difficulties that the inventors in this field have to contend with are the cost of construction and the effective insulation of conductors. With the overhead trolley the current flows out from the power house to the cars through wires carried on poles, and the poles are themselves good insulators; but to make the work doubly sure the conductors are secured to glass insulators, which are practically perfect. The current returns to the power house through the ground and the track rails. As it is easier for the current to circulate in a short path than in a long one, there is a continual tendency for it to jump from the overhead wire through the insulation to the ground, but this is effectually prevented by the very perfect character of the insulation. When the outgoing and

incoming wires are both placed upon or underground the strain upon the insulation is very much increased, for then instead of the two lines being separated by fifteen or twenty feet of pole, which is a very fair insulator, they are separated by only a few inches of earth or perhaps metal, the first of which is a fairly good conductor, while the last is a nearly perfect one. It is evident, therefore, that the insulation proper in an underground or surface system must be of the highest order. If the conduits in which the wires are located could be kept perfectly dry, there would be no difficulty in obtaining insulation that would withstand the strain it is subjected to; but rain in summer and snow in winter will at times cover the tracks and fill [566] the conduits, hence the securing of perfect insulation presents great difficulties. The manner in which inventors have sought to surmount the obstacles can be made clear by the aid of a few illustrations of typical designs.

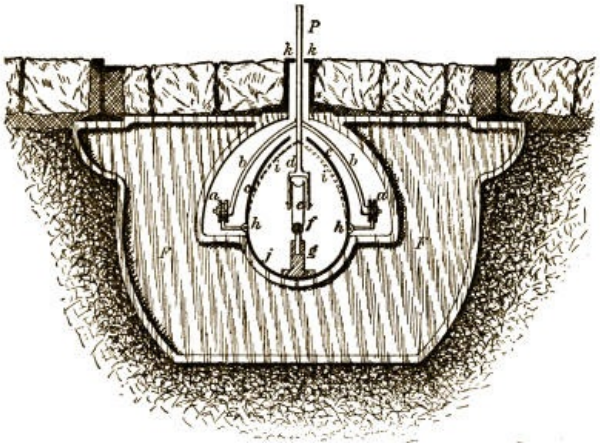

Fig. 25.—Underground Conduit with Protecting Shield for the Conductor.

Fig. 25 shows one of the forms of a class of underground conduits belonging to the inclosed conductor type. The track rails are supported upon the outer ends of large castings, *F F*, commonly called yokes. These are made of such size that the portion below the opening which incloses the conduit may be of sufficient depth to afford the requisite strength to properly support the track. The conductor that carries the current is located at *f* and is insulated from the casing *j*, which forms the lower half of the conduit, by the stands *g*. From the car a bar, *P*, which is called a plow, projects downward through the slot between the rails, *k k*, and on its end is spread out into a fork, *d*, which carries a pulley, *e*. When this pulley is in contact with the conductor *f* the current passes through the plow *P* to the motors upon the car, and thence to the track rails and back to the power house.

As the yokes *F F* and the conduit casing *j* are made of iron and are in metallic connection with the track rails, it is evident that if the conduits should fill with water to the depth of the wire *f* the current would pass directly to the rails, and thus would avoid the longer path through the motors. To prevent this occurrence, the sides of the conduit are inclosed with the sheet-iron covers *c c*, which nominally are in the position shown by the dotted lines *i i*. [567] The plow is also provided with the arms *b b*, upon the ends of which are mounted small wheels *a a*, and these run upon tracks attached to the covers *c c*. As is shown in the figure, the wheels *a a*, running upon the tracks attached to the covers *c c*, cause the latter to spread out to the position in which they are shown. This spreading, as can be readily understood, only takes place for a short distance ahead and behind the plow, but at all other parts of the conduit the sides assume the position *i i*, and thus close the conduit and exclude the water.

It can be easily seen that some difficulty would be encountered in making a tight joint at *h h*, and also that the opening and closing of the sides might not operate as perfectly in practice as upon paper, but it does not follow from these facts that the design is not practical; it simply illustrates that there are many minor difficulties to be overcome in order that complete success may be attained. Many designs operating upon this principle have been patented, and in some of them a great amount of ingenuity is displayed.

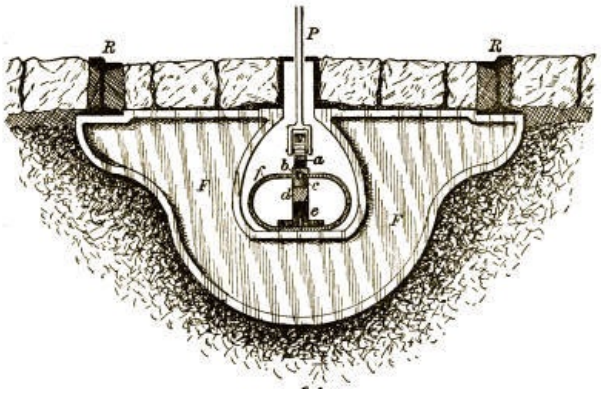

FIG. 26.—UNDERGROUND CONDUIT WITH INCLOSED CONDUCTOR.

Fig. 26 illustrates another type of inclosed conductor which at a first glance appears to be far superior to that just described, but upon closer investigation it is found to be not wholly free from objections that are difficult to overcome. The yoke *F F*, as in the design just described, is made wide enough to support upon its outer ends the track rails *R R*, and is cut away in the middle to an outline conforming with the shape of the conduit. The conductor that carries the current is located at *d*, being supported by the stands *e*. An elastic tube *f* is provided, which is water-tight and thus excludes moisture from its interior, within which the conductor *d* is [568] located. On the top of tube *f* a flexible rail *b* is secured, and this connects with studs *c*, which are within the tube, as clearly shown in the drawing, and so situated that they may be forced down into contact with *d*. Normally these studs are separated from *d*, but when the car comes along, the wheel *a*, mounted upon the end of plow *P*, flattens the tube *f* and thus forces one or more of the studs *c* into contact with *d*. The distance between the studs *c* is such that at least two will always be in contact with *d*, thus insuring a continuous electrical connection with the motors so long as the plow is depressed.

The first impression upon looking at this design would be that it is entirely free from objections; for if we assume that the tube *f* is made of rubber, we can see it in our mind's eye springing up after the plow passes by and thus separating the contacts *c* from *d*, and at the same time yielding freely to the pressure of the wheel *a*. All of this is true, but rubber is not very durable when under such exposed conditions, and to maintain a length of several miles of it in a perfect state for even two or three years could not reasonably be expected; and if it became necessary to renew the tube oftener than this the cost of maintenance would be entirely too great. There is another objection, however, which is more serious, and that is that the conduit will gradually fill up with dirt, and this pressing against the rubber tube would force it out of shape, and thus cause the contacts *c* to bear permanently upon *d*, or else to become so far displaced that they would not touch it when depressed by the plow.

As the rubber tube can not be depended upon, inventors have sought to improve the construction by using sheet steel and making the tube flatter and much wider, so that a section of it would present an outline much resembling an elliptic carriage spring. Such a construction will meet the requirements as to strength and the retention of the contacts *c* in their proper position; but steel expands when warm and contracts when cooled, therefore a long tube would be stretched so much in winter that it might pull apart, while in summer it would be compressed and tend to buckle up and thus be forced out of place. These difficulties can be overcome by providing expansion joints at suitable intervals, so that they are not necessarily proof of the impracticability of devices based upon the principles involved in this design; they simply serve to forcibly bring to mind the fact that the path of the inventor of underground systems is not strewn with roses, no matter in what direction he may turn to find a solution of the problem.

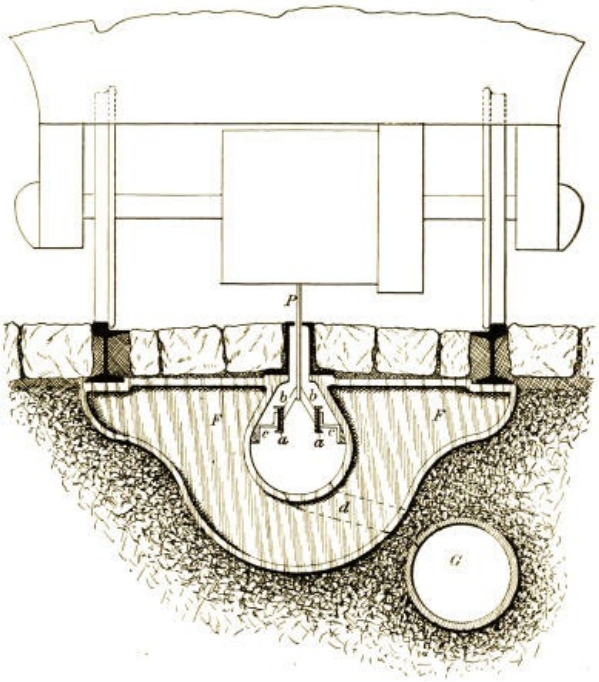

Fig. 27.—Underground Conduit with Exposed Conductors.

The object in the designs Figs. 25 and 26 is to shield the conductor so that it will remain dry should the conduit be filled or partially filled with water. If water could be excluded from the [569] conduit, the casing *j c c*, in the first figure, and the tube *f*, in the second one, would not be required, for there is no difficulty in providing an insulating support that will hold the conductor firmly in place and at the same time prevent the escape of the current; but as soon as moisture collects upon the surfaces of the insulating supports it acts as a conductor, and thus renders the insulation of little value. If water runs into the conduit in such quantities as to come in contact with the conductor, then the effect of the insulation is entirely destroyed; the aim of the inventors, therefore, is to provide means for preventing the accumulation of water or moisture around the conducting wire. It can be readily seen that the shorter the conductor the easier it is to protect it, and this fact has given rise to the development of a great number of designs classified as sectional conductors. In these, two conductors are used, one of which is continuous and so situated and insulated that it can not [570] under any conditions be reached by either moisture or water. The other conductor is made in lengths that vary all the way from fifteen to two or three hundred feet. Normally, these short sections are not connected with the circuit—they are dead, as it is called—but when the car comes along, the plow, by acting upon suitable mechanism, establishes a connection between the continuous conductor and the portion of the sectional conductor that is directly under it, and in this way the current passes to the car. As soon as the car passes beyond a section of the sectional conductor, the connection between it and the continuous wire is broken automatically. Some of these arrangements depend upon mechanical devices, such as levers that are struck by the plow and thereby move a switch that closes a connection between the section and the continuous conductor, but in most instances the switch is operated by a magnet, which may be carried by the car or may be arranged so as to be energized as the car approaches it. Designs of this last type come under the head of electrically operated sectional conductor systems. There are other arrangements in which a magnet carried by the car attracts iron levers suitably disposed along the conduit, and these levers close switches that connect the section of conductor under the car with the continuous one. As the levers are actuated by the magnet, they only hold the switch closed while the latter passes over them; thus [571] the electrical connection is made and broken as the car moves along.

Fig. 28.—View of Street Railway Lines in Washington operated by Underground Conductor of Type shown in Fig. 27.

Most of the designs in which sectional conductors are used can be placed much nearer to the surface of the street than the types illustrated in Figs. 25 and 26, and this is a decided advantage, as it greatly reduces the cost of construction. Any system that requires an underground conduit, with the yokes *F F* to support the track, can only be used by roads upon which the traffic is very great, for the cost of construction would be such as to prohibit its use under any other conditions, no matter how successful its operation might be. For small roads with moderate traffic the question of first cost is of paramount importance, and the only system that can offer a satisfactory solution of the problem for these is one that does not require an underground conduit.

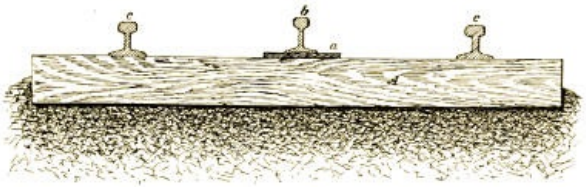

Fig. 29.—Cross-section of Railway Track provided with Third-rail Conductor.

Although many patents have been taken out for systems similar to those described in the foregoing, nothing has been done practically with any of them except in an experimental way. Some are in operation on small roads in out-of-the-way places, being intended principally to illustrate the practicability of the system and thus assist in promoting its introduction elsewhere, but the system that has been adopted in a commercial way is one in which no attempt is made to shield the conductor from moisture and water, and for its successful operation dependence is placed entirely upon the proper drainage of the conduit. This system is well illustrated in Fig. 27. The plow *P* carries upon its end two brushes, *b b*, which are insulated from each other. These brushes rub against the conductors *a a*, which are made of bars of channel iron and are well insulated from the yokes *F F* and the conduit casing to which they are attached by means of the supports *c c*. In the construction shown in the figure the current comes from the generator through one of the *a* bars and returns through the other, but both bars can be used to conduct the current from the generator, in which case the return can be effected through the track rails, just as in the designs already considered. If both the bars *a a* are used to convey the current from the power house the insulation between the brushes *b b* is not required. To avoid the accumulation of water in the conduit the drain *G* is provided with outlets *d*, located at suitable points.

[572]

Although this system is the simplest that can be devised for use in streets or public highways its construction is very costly, so much so that it can only be used in cities where the traffic is so great as to require the running of cars on short headway; and, furthermore, it can not be operated with any degree of success except in municipalities where there is a good sewage system. During the summer months it is liable to be more or less impaired by heavy showers, but the trouble in such cases is only temporary. In winter

time snowstorms are liable to affect it in the same way, especially if, after a heavy fall, a warm wave comes along and produces a rapid thaw.

From the fact that no attempt whatever is made to protect the conductors, one would naturally suppose that every time there is a rain the road would be compelled to shut down; for, as the slot through which the plow travels is open, water can enter the conduit with the greatest freedom, and, in trickling down the sides, would be caught to some extent upon the brackets *c c*, and thus make its way over to the channel bars *a a*, and thereby destroy the insulation. Practice, however, shows that this action does not take place, at least not so often as to produce any serious trouble. The roads that are operated by electricity in New York, and also the lines of the Capital Traction Company, of Washington, D. C., employ this system, and they have been in operation a sufficient length of time to fully demonstrate that the difficulties actually developed by the action of the elements are not of a formidable character. On one occasion the Sixth Avenue road, in New York, was compelled to stop its cars for a short time just after a severe snowstorm, but the failure was not due to impairment of the insulation, according to the statements of the officials of the company, but to the fact that the melted snow froze upon the track and caused the wheels to slip around without sending the car ahead. The fact that other roads in New York, belonging to the same company, are being equipped with the system, is proof that, upon the whole, its practical operation is regarded as satisfactory; but it is very evident that it is not the final solution of the problem. A system to be a decided success must cost very little more than the ordinary overhead trolley, and its construction must be such that it will not easily get out of order. If it is not inexpensive it will not come into use except in places where the authorities will not permit the overhead wires. A surface or underground system ought to be more durable than the overhead, as the wires are not liable to be injured by high winds or the accumulation of ice and snow; and, furthermore, as the conductors are below the ground the danger of burning out motors and generators by lightning would be eliminated, and this is a serious matter with all trolley roads, especially in cities. Country roads do not suffer so much from lightning, because when there is a heavy thunderstorm the generators are stopped and the trolley poles are pulled away from the wire, the cars remaining stalled on the track until the storm passes over. This course can not be pursued by city roads, for the passengers feel that, lightning or no lightning, they must reach their destination, therefore the cars must continue to run and take their chances. Lightning, however, does not strike trolley lines as often in cities as in the open country, owing to the fact that there are so many iron buildings and roofs to attract it in other directions.

[573]

FIG. 30.—VIEW OF A SECTION OF THE NEW YORK, NEW HAVEN AND HARTFORD RAILROAD, EQUIPPED WITH THE THIRD-RAIL SYSTEM.

Fig. 28 shows the appearance of the street surface when an underground system such as is illustrated in Fig. 27 is used. This figure is a photograph of the Capital Traction Company's lines in Washington. After looking at this picture one can not deny that the appearance of the streets of a city is greatly improved when the overhead wires are removed, but underground systems which require a plow to run in a groove are not without objection, for the groove forms a dangerous trap into which the narrow-tired wheels

of light wagons can readily drop, and the toes and heels of horseshoes can be caught. Thus, unless the slot can be dispensed with the greater beauty overhead is obtained at the expense of increased danger on the street surface. There are quite a number of underground conductor systems in which the slot is not used, the current being conveyed to the car by contact made with plates set at suitable intervals between or along the sides of the tracks, and on a level with the street surface. Many of these arrangements appear to be quite practical, but none of them can attract the attention of railroad managers unless it can be constructed at a reasonable cost. [574]

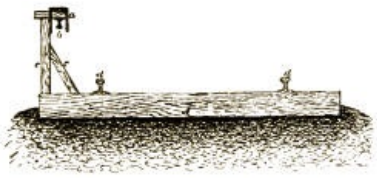

Fig. 31.—Cross-section of Railway Track, showing a Modification of the Third-rail System.

About two years ago the New York, New Haven, and Hartford Railroad published a report of the performance of a branch line that was equipped with electric motors, the current being conveyed to them by means of a third rail. Some of the sensational dailies at once took the matter up and heralded the third rail to the public as something entirely new and sure to supersede the trolley. Now, as a matter of fact, the third rail is one of the oldest arrangements that have been used, and was in daily operation in Baltimore in 1886. It is a very cheap system and well adapted to roads owning the right of way or running upon elevated tracks, but could not be used on public highways or streets. The third-rail system in its simplest form is shown in Fig. 29, which represents a section through the roadbed. The log *A* represents a tie or sleeper, and *c c* are the track rails, while *b* is the third rail through which the current passes to the motors. Between the rail *b* and the tie *A* is placed a piece of insulating material, *a*, of such dimensions as may be necessary. If the track is high above the surrounding ground, so as to not be submerged when there is a heavy fall of rain, *a* may be thin, but otherwise it must be of sufficient thickness to raise the rail above the high-water mark. The car is provided with a wheel or brush to bear upon the rail *b*.

This is the construction used upon the New York, New Haven, and Hartford Railroad, as can be seen from Fig. 30, which is a photograph of a section of the road. The third rail, it will be seen, is raised but slightly from the ties, just about as shown in Fig. 29. One objection to this construction is that persons and animals can receive shocks by touching the center rail and one of the side ones at the same time, as, for example, by standing with one foot on each. Such shocks would not prove fatal to men, as the currents used for railway work are not of a sufficiently high electro-motive force to produce death, but the shock is nevertheless very severe. Horses and cattle would be killed outright, as these animals are not able to withstand as strong a shock as human beings. To render the third-rail system safer, and also to improve the insulation of the conducting rail, the construction illustrated in Fig. 31 has been devised. The only difference between it and Fig. 29 is that the rail *b*, instead of resting upon the ties between the tracks, is carried upon a side support *c c* and is housed in with boards *a a*. To take the current from it a wheel is mounted upon a shaft projecting from the side of the car truck.

[575]

Fig. 32—Electric Locomotive on the Buffalo and Lockport Railway.

From the foregoing brief description of the essential features of the several systems devised for conveying current to the moving car by means of conductors placed underground or upon the surface, it [576]

can be seen that while the result can be accomplished in many ways, and is actually accomplished in a number of instances, nothing has been brought forward so far that is as free from objection as the simple trolley, if we disregard the unsightliness of the latter. It is this unsightliness that has created a demand for something else, but the substitutes, while capable of doing the work, are far more costly and can not be said to be as reliable under all conditions of weather.

The sphere of action of the electric-railway motor is not confined to street railways or suburban transit, but extends to the legitimate domain of the steam locomotive. In many places electric locomotives are used to move freight trains made up of cars of the largest capacity, this same work having been done formerly by steam locomotives. In the city of Baltimore, the Baltimore and Ohio Railroad uses electric locomotives, of greater capacity than any steam locomotives so far made, to draw trains through the tunnel that passes under the city. The general appearance of an electric locomotive can be judged from Fig. 32, which shows an engine of average size at the head of a long freight train.

MM. Bertaux and G. Yver are quoted, in *La Nature*, as relating in their travels in Italy that between Benevento and Foggia, where the railway passes through a tract of wheat fields, a falcon was observed closely accompanying the train. He would graze the windows, fly over the roofs of the cars and turn, and keep constantly dashing down to the ground by the side of the track. A habitual traveler on the road remarked that he had observed this habit of the bird several times a week. The crafty hawk had observed that the eddy made by the train as it rushed through the air overcame the small birds and made them an easy prey, and it had learned to take advantage of the fact. It was also remarked that this particular train, which was the "fast train," was the only one the bird thus pursued.

A SURVIVAL OF MEDIÆVAL CREDULITY.

By Professor E. P. EVANS.

One of the crassest and most impudent and yet most successful frauds of modern times is that recently practiced by Leo Taxil and his associates on the papal hierarchy in their pretended exposures of the Freemasons and the Satanic rites performed by this secret fraternity. On April 20, 1884, Leo XIII issued an encyclical letter in which he divides the human race "into two diverse and adverse classes" (*in partes duas diversas adversasque*): "the kingdom of God on earth—namely, the true Church of Jesus Christ"—and "the realm of Satan." All who are not members of the former belong to the latter, so that there is no alternative between being a good Catholic or a worshiper of the devil. His Holiness then proceeds to show that the headquarters of Satanism are the lodges of the Freemasons, a fact, he adds, fully recognized by his predecessors, who have never ceased to expose and denounce the diabolical character and flagitious aims of these archenemies of the Christian faith. The detailed description of the organization of this order, its devilish purposes, and the horrible crimes committed in order to accomplish them are very queer reading in an official document emanating from an infallible ecclesiastical authority at the close of the nineteenth century. On August 20, 1894, Leo XIII published a decree of the Inquisition putting under ban "Odd Fellows, Sons of Temperance, and Knights of Pythias" as "synagogues of Satan," and excluding them from the sacraments of the Church.

It is no wonder that such an exhibition of credulity, which excited the astonishment of many a Romanist and made all intelligent and unprejudiced persons smile and shrug their shoulders, should have suggested to an arrant wag and incorrigible player of practical jokes like Leo Taxil (pseudonym of Gabriel Jogand) the idea of appealing to this peculiar passion on a grand scale and seeing to what extent the "mother Church" could be led into fraud, as Milton says, like "Eve, our credulous mother." In tracing the development of this audacious plot through all its stages and perceiving by what silly tales and transparent deceptions the Holy Father permitted himself to be duped, one can hardly refrain from exclaiming, in the words of Ben Jonson:

> "Had you no quirk
> To avoid gullage, sir, by such a creature?"

Leo Taxil was born at Marseilles on March 21, 1854, and was therefore thirty years of age when he entered upon this career of [578] intrigue and mystification. From his childhood he had been educated in strictly Roman Catholic schools, and everything was done by his pious parents and teachers to render him sound in the faith. Long before arriving at man's estate he had thrown off these influences and cast in his lot with unbelievers, although he continued to go to mass, confession, and communion. While a pupil in the Catholic College of St. Louis, at Marseilles, he was strongly attracted to the political views of the radical party as set forth in Rochefort's *Lanterne*, and soon began to write for the press; in 1871 he joined the editorial staff of *Egalité*, and published for two years a humoristic journal—*La Marotte* (Fool's Bauble). It is not necessary to give a detailed sketch of this man's life. Suffice it to say that he was violently anticlerical, and was repeatedly fined and imprisoned for articles insulting to the Church and to ecclesiastical dignitaries. On December 29, 1881, at Montpellier, he was condemned to pay a fine of sixty-five thousand francs for publishing a book entitled The Secret Amours of Pius IX. He appealed from this decision, and, after repeated efforts, succeeded in having the indictment quashed. A new edition appeared in 1885, and was announced by large placards, in the center of which was a medallion of the Pope's head, encircled with the heads of a bevy of beautiful women, forming, according to the author, a fitting halo for his Holiness. We may add that the sensational revelations contained in this book, as well as in the Scandalous History of the Orléans and similar works, are for the most part mere figments of the imagination recorded as facts, for the purpose of mystifying a credulous public. In 1880 he founded a "Society of Freethinkers," which, with its numerous branches, numbered in a few years about seventeen thousand members. The remarkable success of this movement was due in a great measure to

the energy with which he advocated it in the columns of the *République Anti-Clericale*, of which he was the editor.

Perhaps the most comical episode in his strange career is his pretended repentance, resulting in the return of this black sheep to the fold of the Catholic Church. In his Confessions the arrant renegade relates how, on April 3, 1885 (April 1st would have been a more appropriate date), while engaged in writing a book on Joan of Arc designed to excite animosity against the clergy, his fell purpose was suddenly shaken by strong compunctions, and soon a fearful agitation convulsed his whole being. His description of his contrition and self-reproaches is quite sensational and thrilling, and shows rare talent as an actor, if we only bear in mind that the whole thing was a farce. "I burst into sobs. 'Pardon me, O God!' I cried out in a voice choked with tears. 'Pardon my many blasphemies! Pardon all [579] the evil I have wrought!' I passed the night in prayer, and resolved on the next day to seek absolution for my sins." He retired from the editorship of the *République Anti-Clericale*, and handed in his resignation at a meeting of the "Anti-Clerical League," of which he was the founder and hitherto the most active member, when he had the satisfaction of being denounced by the presiding officer as a comedian and scoundrel. No one of his former colleagues believed in his sincerity, and yet every one was puzzled to understand the strategic purpose of this retrograde movement. The general impression was that he had been bribed. "You can't fool us by your abjuration!" they exclaimed. "The fact is, you have received a large sum of money from the Vatican." He does not seem to have attempted to refute these charges, nor did he permit them to divert him from the execution of his deep-laid plot. With hypocritical humility, he made full confession to the papal nuncio in Paris, Monsignore Di Rende, who, after subjecting him to several days' penance, embraced him with joy and released him from all excommunications and ecclesiastical censures.

Taxil now began to issue his Complete Revelations concerning Freemasonry, in four volumes, the ostensible object of which was to expose the secret and sacrilegious rites of this order as an organized system of devil-worship, thus confirming by the testimony of an eyewitness the assertions of the Popes, and proving that their decrees and decisions on this point had been bulls in the ecclesiastical and not in the Irish sense of the term. This work, although a mere tissue of fabrications, was greeted by the Catholic press and priesthood with exultation, as an authentic narration containing positive and irrefutable proofs of the diabolic character of the Masonic mysteries. The members of this fraternity, says Taxil, regard the God of the Catholics as an evil principle—a crafty, jealous, and cruel genius, a supernal tyrant, and archenemy of human happiness. Opposed to him is Lucifer, the good genius, the perennial source of virtue and wisdom, the spirit of freedom, and the friend of mankind. For this reason, in the high-grade lodges Lucifer, the reputed father of Cain, Canaan, and Hiram, is adored, under different names indicative of the Supreme Being, as the God of Nature, and the great architect of the universe. In short, while modern freethinking is atheistic and begets a skepticism which, even when not denying God, does not care for him, Freemasonry is essentially a Satanic cult. These words give the sum and substance of the supposititious disclosures which excited such intense joy in the clerical camp. In 1887, when Taxil was received in solemn audience by Leo XIII, "My son," asked the Pope, "what dost thou [580] desire?" "Holy Father, to die this moment at thy feet were for me the highest bliss," replied the kneeling penitent. "Not so," was the benignant response of the successor of St. Peter; "thy life is still very useful in combats for the faith." His Holiness then pointed to Taxil's writings on the shelves of his library, declaring that he had read them all through with extreme satisfaction, and encouraged him to continue his exposures of these satellites of Satan and their abominations. Taxil left the Vatican with the papal benediction and with the firm conviction that he could devise no better means of currying favor with the Apostolic See than by inventing tales about the homage paid by the Freemasons to the devil, and determined to work this rich vein to its utmost capacity. He also came to the conclusion that he could imagine nothing so absurd that it would not be received in Catholic circles as authentic and indorsed by infallible authority.

His work had an immense pecuniary success, and thus attained the chief object which he had in view. More than one hundred

thousand copies of the original French edition were sold, and it was translated into English, German, Italian, and Spanish. This result is not so surprising, if we remember that nearly all the bishops and other clergy of the Catholic Church acted as voluntary and extremely zealous agents for the diffusion of these Revelations, which they seemed to regard as a new apocalypse designed to unveil the mysteries of Babylon and disclose the present doings of Satan and dominion of antichrist. Of the utterly apocryphal character of the Revelations they do not appear to have entertained the slightest suspicion, although the hoax was clearly perceptible to every unprejudiced mind. The German translation by the Jesuit Father Gruber, which appeared at Freiburg, in Switzerland, and at Paderborn, in Westphalia, omitted the volume entitled The Masonic Sisters, on account of the indecency of its contents, although accepted as true and deemed especially damaging to the Masonic fraternity. However desirable it might be to tear away the mask of philanthropy from the face of Freemasonry and let the world see its devilish features, it was thought best not to outrage the moral sense of the community by uncovering "the filthiness of the hellish crew."

In 1892 Taxil's coadjutor, Dr. Bataille (a pseudonym of Dr. Karl Hacks, a German from the Rhineland), began to issue a serial publication, entitled The Devil in the Nineteenth Century, purporting to embody the results of his observations as ship's surgeon during his travels in various countries, and especially in the Orient, where he had opportunities of studying Satanism in its diverse manifestations. He begins by referring to the encyclical letter *Humanum genus*, already cited, in which Leo XIII divides the [581]
human race into worshipers of God and worshipers of Satan, and then proceeds to adduce facts proving the correctness of this classification. It is, in reality, a bold burlesque of the papal circular, as, indeed, it was intended to be, and would doubtless have been laughed at for a time as a clever persiflage, if the dignitaries of the Church had not taken it seriously, as they were expected to do. Dr. Hacks confessed to an "interviewer," in 1897, that no sooner had he read the pontifical circular in question than he saw in it "a rare opportunity to coin money out of the crass credulity and boundless stupidity of the Catholics. It needed only a Jules Verne to clothe these extravagant fancies in an attractive garb. I resolved to play the part of this Jules Verne. Strangely enough, the same idea occurred to others. I therefore joined forces with Leo Taxil and a few friends, and began to publish The Devil in the Nineteenth Century, the success of which is well known.... I had traversed many lands and got up marvelous stories, the scenes of which were laid in remote regions, which I was sure no one would visit in order to test the truth of my assertions." Besides, he counted on the silliness of the persons with whom he had to deal, and felt certain that if he should tell them he had been fooling them they would not believe him, but would remain convinced that all his inventions were strictly true. He could not conceive of a body of ecclesiastics as ready to discard a belief which served their turn, however evident its absurdity might be to other minds. "Sometimes I fabricated the most incredible stories, as, for example, that of the serpent inditing prophecies with its tail on the back of Sophia Walder, or that of the demon, who, in order to marry a Freemason, transformed himself into a young lady, and played the piano evenings in the form of a crocodile. My colleagues were aghast, and exclaimed, 'You'll spoil the whole joke with your nonsense.' 'Bah!' I replied. 'Let me be, and you will see!'" And they did see how eagerly such gross falsehoods were accepted as positive facts. Protestants without exception are denounced as godless apostates. Every Lutheran is a Luciferian in disguise. Singapore, he says, like every British colony, is settled by knaves, footpads, and all sorts of criminals. The Protestant Englishman is, at the bottom, an embodiment of scoundrelism coupled with Satanism. There is a strangely infernal element in the social life at Singapore. "The British matrons and even the maidens are incarnations of vice and godlessness. The young English woman dedicates all her charms and intelligence to the service of Satan, whose apostle and agent she is; cursed by God, she is the dearly beloved paramour of Lucifer; a woman only in name, she is in fact [582]
absolutely infernal—an actual deviless." Hacks asserts that in a Presbyterian church at Singapore he discovered a secret tabernacle for the worship of Satan. The pastor opened the door, and there was a Baphomet, with all the Palladistic (Satanic) apparatus—goblet, host, and dagger—standing before his eyes.

Albert Pike, Grand Master of the Freemasons in Charleston, S. C., is called the "Satanic Pope," and is said to have a telephone invented and operated by devils, whereby instantaneous communication is possible between the seven principal directorates at Charleston, Rome, Berlin, Washington, Montevideo, Naples, and Calcutta. He has also a magic bracelet, by means of which he can summon Lucifer at any moment. "One day Satan took Pike gently in his arms and made a trip with him to Sirius, traversing the whole distance in a few minutes. After exploring the fixed star, he was brought back safe and sound to his room in Washington." Whether he found the star as hot and scorching as its name implies is not stated. Hacks discovered, under the cliffs of Gibraltar, mysterious caverns with laboratories in which devils prepared microbes for generating and diffusing epidemics. He was politely received by Tubal-Cain, the director of the establishment, who addressed him in pure Parisian French, from which we may infer that this is the language of the lower regions. On his departure Hacks was presented with a small vial, the contents of which would suffice to produce a fearful epidemic of cholera. No less an authority than Professor Bautz, of the Prussian Academy at Münster, tells us that the volcanoes are the flues of hell, and it was probably this contribution to the topography of Tartarus that led Hacks to look for the devil's workshop in the cavities of mountains, which, however, being used for infernal purposes, would hardly be what Milton calls "umbrageous grots and caves of cool recess."[8]

The following may be cited as a specimen of the manner in which historical events were perverted by Hacks to subserve his purpose: Before the capture of Rome by the Italian troops in 1870, a secret meeting of Freemasons was held in Milan, at which Riboli, Cucchi, and General Cadorna were present, and the revolutionary [583] deliberations were rendered piquant by dreadful blasphemies. Thus General Cadorna, a renegade priest, parodied the consecration of the host with a piece of bread, which he finally threw into the fire with the words, "In honor of Lucifer!" Thereupon Lucifer rose up in person through the floor, gazed benignantly for a moment on his faithful followers, and said, "The moment is come for firing the third salvo of cannon." A month later General Cadorna entered Rome through the breach of the Porta Via. In Luciferian lingo, the first salvo was the Reformation and the second the French Revolution, while the third victory of Satan was the overthrow of the Pope's temporal power.

Hacks relates that in Freiburg, Switzerland, there was a Masonic temple of Satan hewn in a rock and provided with altars and all the paraphernalia of this cult. There men and women assembled in the costume worn by our first parents before the fall. Attached to the lodge was a brothel, the scene of the most disgusting debaucheries. One altar, in the form of a triangle with an image of the demon Baphomet, was used for stabbing the body of Christ, in the form of consecrated wafers, with a dagger. At this altar, too, was said the so-called "black mass," an invention of the Grand Master Holebrook and Albert Pike, of Charleston. During this service hymns were sung to Satan. The consecrated wafers were procured by Miss Lucia Claraz, of Freiburg, who stole them while pretending to partake of the communion, and passed the night before committing the theft in the wildest orgies. This incredibly foolish story was published in the *Moniteur de Rome*, against which Miss Claraz, a lady "piously inclined and morally irreproachable," according to the testimony of the Bishop of Freiburg, brought suit for defamation. The court sentenced the editor, Monsignore Vöglin, to a fine of twenty-five thousand lire and four years' imprisonment.

These examples suffice to show the wretched stuff which Hacks hashed up for the edification of the clerical and the entertainment of the carnal-minded public. Even the silly statement that he saw a gigantic tree bow down before Sophia Walder, the predestined great-grandmother of antichrist, and present her with a bouquet, did not shake the faith of the true believers. The editor of the *Revue Mensuelle* declared, in 1894, that Dr. Bataille had really made all these discoveries on his travels, and that his honesty and sincerity were beyond question. This was the attitude of the whole clerical press almost without exception, as well as of abbots, bishops, cardinals, and the highest dignitaries of the Church. Even as late as July, 1897, when the imposture had been exposed and confessed, a Parisian Catholic journal continued to regard "the mystification as [584] more apparent than actual, and the documents adduced as chiefly

authentic"; so difficult is it for minds thus constituted, with the rational faculties dwarfed and stunted by being constantly kept in the leading strings of credulity, to recognize the falsity of what they wish or are told to believe.

Another of Taxil's confederates was Domenico Margiotta, according to his own account a native of Palmi, in southern Italy, and professor of literature and philosophy. His principal work, Adriano Lemmi, Supreme Head of the Freemasons, published in French in 1894, gives a long list of his titles, designed to impress the public by indicating his high position in the Masonic order. Hacks calls him a "Member of the Sovereign Sanctuary of the Oriental Rite of Memphis and Mizraim," a purely fictitious designation. This cunning device was also crowned with complete success, and caused the fabricated disclosures to be hailed with enthusiasm. Here, exclaimed the clerical journals, we have "not an apprentice or novice like Taxil, but one of the highest dignitaries of universal Freemasonry and Luciferianism, who is initiated and instructed in all its mysteries and occult observances," being apparently ignorant of the fact that Taxil was in the main the real author of the book.

One of the most common accusations brought against the Freemasons is that of desecrating the host by stabbing it with a dagger. A German Catholic journal, The Pelican,[9] affirms that not only Masonic devil worshipers, but also Jews, infidels, and heretics in general commit this sacrilege in order to show their deadly hatred of Christianity. In proof of this charge, the following "historical fact" is published in the number for July, 1897: Several consecrated wafers were once stolen by Jews from a church at Langenses, in Silesia, and, after being pierced through with knives, were hidden in the forest. They were discovered by a Polish nobleman, whose four horses, as he was driving by, suddenly kneeled down and refused to go on, although he beat them with his [585] whip. He then descended from the carriage, and soon found the wafers covered with blood. They were carried back with solemn ceremony to the church, which became a place of pilgrimage with a wonder-working pyx. What a hardened and hopeless skeptic a man must be, who is not convinced by conclusive evidence of this kind, when even horses bear witness to the truth by their genuflections!

Still more sensational was the part played in this spicy comedy by Miss Diana Vaughan, whom Taxil introduced to the public as a descendant of the Rosicrucian alchemist and Oxford professor Thomas Vaughan, and who was said to have in her possession a copy of the written pact with Satan, signed by her ancestor on March 25, 1645. The young lady claimed to have been born in Paris on February 29, 1874. The fact that there was no February 29th in the year 1874 would make this date an impossible natal day for ordinary mortals, but a person with Luciferian blood in her veins would naturally take no note of the divisions of time as recorded in human calendars; for, according to Taxil, her forbear was the goddess Astarte, who appeared to Thomas Vaughan on a summer night in 1646, while he was sojourning among the American Indians, in all her marvelous beauty, bringing with her a bed surrounded with flames and attended by little demons bearing flowers. She approached Vaughan and put a wedding ring on his finger, and eleven days later gave birth to a daughter named Diana, from whom the Miss Diana Vaughan in question traced her descent. Several instances of similar commerce with incarnate demons are said to have occurred in the history of her family, so that she inherited a strong Satanic taint; even her own mother was guilty of the same criminal conduct. Her inherited qualities were carefully fostered by education, inasmuch as she was brought up by her father and uncle on strictly Luciferian principles. One day, when her instructors were praising Cain and Judas as ideals of excellence, she expressed some doubt of the superior worthiness of the fratricide and venal traitor. This dangerous unbelief was attributed to angelical possession, and it was soon ascertained that the archangel Raphael was the cause of the lapse from Luciferianism. Recourse was had to exorcism, the whole process of which, as described by Taxil, is a clever travesty of the ceremonial prescribed by the Romish Church for the expulsion of evil spirits. The dance performed by the father and uncle on this occasion consisted of the same saltatory movements that are executed by the "procession of jumpers" every year at the grave of St. Willibord, in Echternach, Luxemburg.[10] Devil's ointment took the place of holy oil, and the exorcism ended with the sacrifice of a [586]

black hen; thereupon "Raphael" went out of her, and simultaneously with his exit all the panes of glass in the house were broken into fragments and fell to the ground with a tremendous crash. The marvel is that bishops and priests accepted this ridiculous story as an authentic and edifying narration, instead of rejecting it with horror and disgust as a palpable burlesque of their own approved methods of casting out demons, and particularly of the *Exorcismus in Satanam et Angelos Apostatas*, composed by Leo XIII and issued by him November 19, 1890. It is evident that Taxil had this document in his eye, and intended to hold it up to derision; to calm the fears of the simple-minded, who were puzzled and perplexed by the striking resemblance of diabolic orgies to divine ordinances, he explained it on the general principle that "Satan is the ape of God."

After being freed from the influence of Raphael, Diana was placed under the tutelage of Asmodeus, who, as her guardian devil, watched over her, shielding her from bodily harm and helping her to resist the wiles of angels. One day when she was wandering in the woods she was attacked by negroes, but Asmodeus came to her rescue, and bore her safely to her home through the air. Another time he caught her mettlesome courser by the bridle as he was running away, and when the chief of Garibaldi's staff, Bordone, insulted her, Asmodeus twisted his neck so that his face looked backward. For three weeks he was obliged to take a retrospective view of life and of his own conduct, when Diana, in the kindness of her heart, set his head right again. On these occasions the tutelar demon usually appeared in the form of a fine young gentleman, and emitted an aroma of balsam, which seems to have been as inseparable from him as is the scent of musk from a modern dude or modish dame. He spoke of her as his bride, and often took her on pleasure trips to paradise, purgatory, and other remote regions; once when she was greatly depressed, because her Luciferian rival, Sophia Walder, had got the better of her, he consoled her by making an excursion with her to Mars, where they rode on Schiaparelli's canals, sailed on the Sea of the Sirens, and strolled like pygmies among the gigantic inhabitants of that planet.

[*To be concluded.*]

Contrary to the common supposition that the astronomy of the ancients was based exclusively on the geocentric hypothesis, Mr. G. H. Bryan says in Nature: "Schiaparelli has shown that Heraclitus Ponticus, a disciple of Plato, had already accepted the theory that the sun is the center of the orbit of the planets, while the earth is the center of the universe and of the lunar and solar rotations—a theory substantially that of Tycho."

"RIBBON LIGHTNING."

By ORANGE COOK.

In the summer of 1898, W. H. Osborne, of Chardon, Ohio, an amateur photographer of some experience, secured the accompanying photograph of a lightning flash which seemed to us to show certain peculiarities that entitle it to a public notice and a permanent record. The picture shows three flashes, of which the distant and faint one at the right and the bright one at the left were simultaneous, while the center one occurred a few seconds earlier. Nothing about the thunder that followed the last and bright flash suggested that it was specially near, but an examination of the picture when developed and a comparison with the features of the landscape showed that it had come to earth about fifteen rods from the place where Mr. Osborne stood with his camera. Mr. Osborne and myself carefully searched the locality indicated, but failed to find even the slightest mark caused by the discharge upon any object or in the earth.

Measurements at this place give the width of the ribbon of light, if it stood at right angles with the line of sight, about eight feet. This ribbon of light is seen to consist of six lines, approximately parallel, of unequal brightness, a pair being at each edge and a pair near the center. The space between these pairs is crossed by many nearly horizontal lines and a few oblique ones, while that between the right-hand pair is crossed by oblique lines only. The horizontal lines at the right of the center become curved downward, which, with the increased brightness of the whole toward that side, suggests to us that the ribbon of light did not lie in a plane, but was concave toward a point at the observer's left. That the ribbon did not stand at right angles with the line of sight, but was nearer the observer at the right-hand edge, is also shown by the inequality of the lower termination of the six vertical lines referred to above. The ones at the left either rest upon or are hidden behind a rise of ground, whose crest can be traced for a little distance each side of the flash, while those at the right come lower, falling between the observer and the ground at that point. Probably, when measured upon this diagonal and curved line, the width of the flash was fifteen or twenty feet. [588]

Mention has already been made of the fact that the accompanying thunder was comparatively light, and not at all like that ordinarily heard when lightning occurs within so short a distance. Possibly this, as well as the absence of marks at the point where it reached the earth, might have been because the discharge was of very low tension.

[A very similar lightning flash was described and pictured in the issue of the Electrical World and Engineer for October 28, 1899, by A. E. Kennelly, who suggested the following explanation: A lightning flash passed through the air on the left-hand side of the ribbon of lightning (the wind was blowing from right to left) and broke a hole in the air along that line. This discharge may have been oscillatory, and may have lasted in all any time up to about $^{1}/_{100}$ of a second. The discharge then ceased for lack of electricity, but a fresh charge from the cloud being gathered immediately afterward, or in about

$^1/_{30}$ of a second from the first rupture, a new discharge passed through the same hole in the air, which had not had time to seal up. There might thus be fourteen successive flashes (this was the number of distinct flashes making up the ribbon in the photograph), each averaging about $^1/_{25}$ of a second apart, through the same hole, owing to the imperfect conducting qualities of the clouds overhead, meanwhile the hole having been carried from left to right in the picture, across the line of sight (by the wind), and thus producing the appearance of a broad ribbonlike flash. Professor Trowbridge, of Cambridge, has suggested the possibility that many of these apparently curious electrical phenomena may be of purely optical or physiological origin—that is, may arise through the abnormal behavior of the eye or the camera lens toward intense lines of light, such as lightning flashes.—Ed.]

CROSS-EDUCATION.

By E. W. SCRIPTURE,
DIRECTOR OF THE PSYCHOLOGICAL LABORATORY, YALE UNIVERSITY.

Some years ago I made the following simple experiment: I arranged a rubber bulb, like that used for releasing a photographer's shutter, to connect with a bottle, from which rose a long, vertical glass tube. The bottle contained mercury, and the long tube reached nearly to the bottom. Every part was air-tight, so that when anybody squeezed the bulb the mercury was forced up the vertical tube. It was what is known as a mercury-dynamometer.

During experiments with this dynamometer, what was more natural than to think of trying what would happen if one hand were practiced daily in squeezing the bulb? So one of our graduate students, Miss E. M. Brown, was set to work in the following manner: On the first day she squeezed the bulb as hard as possible with the left hand, while an assistant noted the height of the mercury; this was repeated ten times, and the results were averaged. Immediately thereafter she took ten records with the right hand. Then, on the following days, with some intermissions, she practiced the right hand by squeezing ten times on each occasion. On the last day she again tested the left hand, which had not been practiced in the meantime. The records ran as follows:

	DAY								
	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eight	Ninth
	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
Right hand	28.8	33.7	35.6	36.6	40.9	44.7	47.0	48.8	48.6
Left hand	29.9	....	....	....	....	....	....	....	42.3

Thus the left hand had gained about fifty per cent in strength through practice of the right hand. This peculiar phenomenon of transference of the effects of practice from one side to the other I have ventured to call "cross-education."

The phenomenon was curious enough to suggest other experiments. Another student, Miss T. L. Smith, was set to trying to insert the point of a needle at the end of a rod into a small hole in a drill-gauge without touching the sides. The first experiment consisted of twenty trials with the left hand, with a success of fifty per cent. Immediately thereafter twenty trials were made with the right hand, with a success of sixty per cent. On the following day and on each succeeding day two hundred experiments were made with the right hand, with successes of 61, 64, 65, 75, 74, 75, 82, 79, 78, and 88 per cent. On the last day the left hand, which had not been practiced in the meantime, was again tried, with a success of seventy-six per cent. [590]

These last experiments remind us of certain familiar phenomena. It has frequently been noticed that persons taught to write with the right hand become able to write backward, but not forward, with the left hand. This is the so-called "mirror writing," which appears correct if seen in a mirror. The first published observation of this fact exists in a letter from H. F. Weber to Fechner, the founder of experimental psychology. Fechner, moreover, noticed that with the left hand he could make the figure 9 backward better than in the regular way.

Curiously enough, the principle of cross-education has been put to practical use. A letter (with permission to publish) has been received from Oscar Raif, Professor of Music in the Berlin Hochschule:

"In the spring of 1898 I made an experiment with twenty of my pupils. I began by taking the average speed of each hand with the metronome. The average of the right hand was [j] = 116 (= four times 116 in the minute) [464 beats], and for the left hand 112 [448 beats]. I gave them exercises for the right hand only (finger exercises, scales, and broken accords) to develop rapidity. After one week the average of the right hand was 120 [480]; after two weeks, 126 [504]; three weeks, 132 [528], etc. After two months the right hand yielded 176 [604]. Then I had them try the left hand, which averaged 152 [608], whereas in November the average was only 112 [448]. In two months' time, absolutely without practice, the left hand had risen from 112 [448] to 152 [608]. A few of my pupils had

some difficulty in playing the scales in parallel motion, but were able to play them in contrary motion.

"The tenor of my work is that in piano playing the chief requirement is *not* that each single finger should move rapidly, but that each movement should come at exactly the right time, and we do not work only to get limber fingers, but, more than that, to get perfect control over each finger. The source of what in German is called *Fingerfertigkeit* is the center of our nervous system—the brain."

[Transcriber's note: [j] stands for musical symbol of quarter note]

These facts, however, require further investigation, for it is evident that we must begin with the fact of cross-education and proceed to more complicated cases. Indeed, cross-education has shown itself to be one step of a ladder up which we must climb even if there were no other motive except that of curiosity as to what we could find at the top. If practice of one hand educates the other hand, will it not also educate the foot? Again, if practice of one hand [591] in squeezing a dynamometer develops the strength of the other members of the body, will it not also develop their dexterity or their advance? Again, if the development of voluntary power—let us say, frankly, "will power"—in one direction brings about a development in other directions, why should we limit the transference to muscular activity? Why can we not expect, that the development should be extended to the higher forms of will power that go to make up character? The outlook begins to be stirring on account of its vastness. If the last principle be admitted, there seems no argument against the claim that some forms of manual training, such as lathe work and forge work, are just the things to develop moral character. By the same reasoning we would be obliged to admit the often-made argument that training in Latin, Greek, and mathematics furnishes a means of general mental development. If we admit the principle, we find ourselves at once involved in important educational controversies. However we may think in respect to these questions, it is plain that it is worth while to climb a ladder which has such an outlook at the top. Let us begin.

In the first place, the fact of cross-education is established. Let us ask in what this education consists. On this point some curious observations have been made by Prof. W. W. Davis,[11] now of Iowa College. The subject of the experiment began by raising a five-pound dumb-bell by flexing the arm at the elbow; this called into play chiefly the biceps muscle for lifting and the forearm muscles for grasping. This was done as many times as possible with the right arm, and then, after a rest, with the left arm. The subject then entered upon a practice extending from two to four weeks; this consisted in lifting the weight with the right arm only. At the end both arms were tested as at the start.

The results were strange enough. The unpracticed left arm gained in power as we expected, but it also gained in size. Careful measurements were made by Dr. J. W. Seaver, of the Yale Gymnasium, on the girths of both upper arm and forearm. Let us compare the gains in girth with the gains in power:

Subject.	Gains in girth.				Gains in power.			
	Right biceps.		Left biceps.		Right arm.		Left arm.	
G	5	mm.	-5	mm.	820	flexions.	200	flexions.
J	2	"	0	"	400	"	225	"
K	4	"	2	"	724	"	514	"
H	13	"	6	"	950	"	30	"
B	6	"	11	"	900	"	75	"
I	8	"	3	"	750	"	75	"

All subjects had gained power in the unpracticed left arm, three [592] of them largely and three slightly. All but one had gained in the size of the unpracticed left biceps. Strangely enough, those who had gained most in power had gained least in size. The case was quite similar in regard to the girth of the forearm. The gains in power were unquestionably mostly central—that is, in the nerve centers—and not in the muscles. Yet there was also a strange but unquestionable gain in the size of the muscles at the same time.

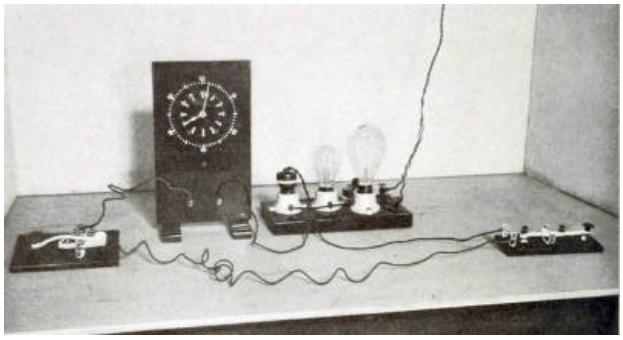

FIG. 1.

We have arrived at the second step of the ladder, which is: The gain by practice which shows itself in cross-education consists in a development of higher nerve centers connected with the two sides of the body. We must next ask: Is this effect of practice confined to the symmetrical organ, or does it extend to other organs? This question was answered by a peculiar experiment.

The experiment consisted in testing the effect of educating one of the feet to tap as rapidly as possible on a telegraph key. The apparatus is shown in Fig. 1. The clocklike instrument is really a piece of clockwork actuated by a magnet, so that it counts up one point every time the electric circuit is closed. The electric circuit is comprised of a battery and two keys. Any form of battery will do; the one in the figure is a "lamp battery"—that is, an arrangement of lamps in series and in shunt, such that the ordinary high-voltage city current is conveniently transformed into a low-voltage current. The key to the left is the experimenter's key, and that to the right the subject's key. When the subject is set to tapping on the latter key the counter will register whenever the experimenter keeps his key closed.

For the actual experiments by Professor Davis the subject's key [593]
was removed to a distant room. Here there were three keys of this kind, any one of which would register. One key each was -arranged for tapping with the big toes; the third key could be tapped by either right or left index finger.

On the first day all four digits—right and left index fingers and right and left large toes—were carefully tested in tapping as rapidly as possible. Thereafter the right large toe was practiced daily in tapping for several weeks, the other digits being left unpracticed. At the end all four digits were again tested. Four of the six persons experimented upon showed a gain for the right large toe—that is, for the digit practiced; the other two showed a slight loss, due unquestionably to "over-practice," or "over-training." All of those who gained for the right large toe gained for the other digits also. Their average gains were: Right foot, thirty-three per cent; left foot, thirty-one per cent; right hand, twenty-one per cent; left hand, thirty-one per cent. Even both of the "over-trained" men gained for the left foot and one of them gained for the left hand. Thus we have reached the third step—the effects of practice are extended to various parts of the body.

Beyond the third step the experimental investigations have not yet advanced, but I believe that sooner or later we shall be able to establish the fact that development of those forms of the will involved in simple muscular activities does also develop the more complicated forms that express themselves in acts of a mental nature.

It has long been claimed that sports, games, and manual occupations are among the best developers of character. Football develops solidarity of feeling and action; running rapids or cross-country hunting develop coolness in danger and promptness and firmness of judgment; wood-turning requires boldness and foresight; forge work requires regulation and reserve of power, and so on. This is no place for an account of the psychology of sports and occupations, but if the reader has ever tried any of these things and failed he will easily recognize the lacking mental quality.

Yet there has never been but one attempt, as far as I can learn, to organize a system of manual occupations on the basis of this principle. The success of the attempt furnishes, I believe, the still-lacking laboratory proof of the principle itself. I refer to the remarkable experiment of Mr. Z. R. Brockway, Superintendent of the Elmira Reformatory.

Most of the young felons sent to the Elmira Reformatory are set to learning trades, by which they can support themselves on leaving. Those, however, who are too stupid to even learn the simplest trade [594] are put into a manual-training school, in the hope that their brains can be sufficiently developed to enable them to keep out of the prison or the asylum. Those who are so stupid that they have difficulty in learning the alphabet or in counting their fingers are put into a kindergarten, where they practice on letter blocks and sticks and straws.

Those who are too stupid to learn a trade are the ones of interest here. Three main lines of defect are recognized in Superintendent Brockway's classification of them. Those who are intellectually weak, but of fair power of self-control, are classed as Group I; those who are reasonably bright, but are unable to get along because they can not control their impulses, are classed as Group II; those who fail on both sides are classed as Group III.

Group II is composed of those who are for the most part devoid of moral sense—those who fight, swear, assault officers, are licentious, and generally unresponsive to the usual reformatory measures. To this class belong some of the most intellectual inmates of the reformatory, but this intellectuality runs riot on account of weakness of character. How are their characters to be built up? They are required to devote most of their waking hours to athletics and calisthenics, wood-turning, making wooden patterns for castings, mechanical drawing, sloyd, clay modeling, and chipping and filing metal. These exercises have been selected on account of their character-building qualities.

The work is a great success. Nearly all inmates subjected to this building-up process finally graduate with sufficient self-control from the manual-training department into the trades school. A concrete example will give an idea of the change produced in the pupil. The record of No. 6,361 is instructive. The account is taken from a report by the manual-training instructor, R. C. Bates:

"The pupil, previous to his assignment to manual training, had earned for himself the sobriquet of 'dangerous man' among the officers and inmates. His offenses have been mostly threatening language, lying, contraband articles, talking, fooling, assaulting officers, and institutional crimes of that nature.

"We begin his record in September, 1895, when he was reduced to the second grade for fighting. October and November he lost three marks each for lying and threatening language, and, by the influence of September markings, caused his reduction to the third grade, or incorrigibles, a closely defined group. He was in the third grade two months and three days, when he was placed in the foundry, where, amid blinding smoke, stifling air, and the task system, it was thought he would tone down, upon the theory that the muscular demands of such a place on a 124-pound body would vitiate sufficiently to weaken the will and curb the disposition to [595] riotous acts.

"From January 15th to February 15th he was on modified treatment. On February 18th he was unconditionally restored to the second grade. February and March he did fairly well, losing one mark each month, but in April his period of passably well-doing was checked by his committing an assault, along with assumption of authority, and on the 27th of April he was returned to the third grade for the second time, remaining in the same two months and three days, when he was again placed on modified treatment, and did well for three months, when he fell again, this time for fighting, losing six marks in October. In November he made a perfect month, securing promotion to second grade.

"On December 15, 1896, he was assigned to manual training, Group II; object, development of self-control, with subjects as follows: Athletics, drawing, sloyd, woodwork, chipping and filing, molding. Each subject one hour and a half per day, five days per week. The influence of the new environment sustained the effort made in November to improve, and, by securing a perfect month in December, all his past was blotted out and he was restored to the lower first grade again, through 'amnesty,' on December 25, 1896.

"Thus, on December 25, 1896, he was where he was institutionally classed at the time of his admittance two years and three months ago—viz., lower first grade, from which all who are committed begin the reformatory course of treatment, additionally thereto in the manual-training department. His development now

begins. In January, 1897, he lost two marks as a result of school failures, but in February he secured a perfect demeanor record; in March he lost two marks; April and May were perfect months in all respects, and he was graduated from manual training in May, returned to institutional life, and assigned to the exercise squad in the morning and stone masonry in the afternoon. Later his daily assignment was changed, placing him in the molding class of the technological department to complete trade. His development was complete and permanent. He was returned to the manual training as *assistant instructor* in the molding class, and is now doing well in all departments, having been promoted to the upper first grade in August and ranking as sergeant in 'I' company."

This record is only one example of many.

When manual-training schools organize their courses on the principle of adapting the exercise to the ability to be developed, we shall have abundance of similar proof. When these facts have been incontestably established, there will be a means of satisfying the complaints of those who are constantly attacking our schools [596] because they develop intellect and ruin character. "What is the use," say they, "of teaching children to read and think if you do not make them honest and truthful? How is it better for the community to educate liars and thieves merely that they may lie and steal successfully in business and politics, where they can not be caught, rather than to leave them in the slums, where the police can get them?" The accusation is bitterly unjust in many ways, but its force can be met by introducing a system of character building based on a careful study of the means of developing truthfulness, honesty, carefulness, persistence, bravery, courage under defeat, and the other qualities that go to make up a true man. The foundation of this system is to be found, I believe, in the *principle of character-building by motor activity*.

The ladder of cross-education will be slowly climbed by psychological investigators; if they find at the top a principle of such value and wide application, surely the climb will have been worth the time and trouble.

THE MORBID "SENSE OF INJURY."

By W. F. BECKER, M. D.

As a fog about a ship removes it from exact relations to surroundings, so, from the standpoint of morbid psychology, we may fancy the mind peering through a more or less misty envelope to the true adjustment to things—the "glass" through which we see "darkly." Were all action and reaction of the mind to surroundings perfectly adapted, there could be such a thing as *absolute* sanity. So long, however, as evolution with continuous readaptation and the processes of dissolution with attempted adaptations continue, so long can there be but groping, imperfect relations to surroundings, so long must there be defective or morbid mental action, and sanity and insanity therefore but relative terms. Thus many symptoms of the insane appear to be but varying degrees of the morbid mental manifestations of health, and we may assume *a priori* that they have a common genesis and can be identified for study. If we take, for example, one of the commonest of these—viz., the idea of persecution among the insane—we may safely identify it with the "sense of injury" equally common among the sane.

By this "sense of injury" is meant that vague sense which afflicts many of us at times of being the object of hostile feelings on the part of others. No doubt we often *are*, for, in the stress of necessary rivalry and conflict upon which progress depends, we give and take [597] injuries. But there remains a large excess of this "injured" feeling which can not be so explained, or which is disproportionate to its cause or entirely gratuitous, and is thus shifted into the field of morbid psychology. This only is here treated—the *morbid* sense of injury.

It seems to find an easy entrance to the mind from a mere feeling of being ill used or stinted in sympathy to the entertainment of serious grievances or persecutory ideas. In certain temperaments it is marked. On so-called "blue" days we are constantly moved to a "sense of injury" from fancied aloofness of our friends. Madam Lofty slights us, and our jaundiced imagination has it that she has heard something detrimental and dislikes us. But lo! to-day, when the liver is released, madam smiles sweetly, and never heard a thing.

So in suspicious people. They entertain a chronic state of mind, by which the acts of others are given an invidious construction. They anticipate ill will, carrying the *chip* on the shoulder. Of two constructions of a given situation, they leap to the more offending. Some take on the vindictive attitude as a result, approaching that type of insanity known as *paranoia*, of which Guiteau and Prendergast were conspicuous examples; others are humiliated, as a consequence approaching the *melancholia* type of insanity, each illustrating again how the sane and insane states are paralleled. Many come to bear the outward marks—the stigmata of this mental attitude, approaching sometimes the "asylum" face, like that of the insanely suspicious Rousseau. We all know such faces, with their hard, set expressions, as if forever sealed against any tender of good will.

By a curious fact, those who invite ill will seem often to get it. Society, based on a reciprocity of faith, seems to have no smiles to bestow upon the misanthrope. It bids him, "Laugh, and the world laughs with you." It so comes to pass that many of them acquire some real ground for their "sense of injury," and in the long run that real quarrels are precipitated from this atmosphere of suspiciousness. Indeed, this is the psychology of most quarrels. The *effect* of imaginary grievances comes in turn to be the *cause* of real ones. Thus into an incident between two persons, one of them mistakenly reads an affront to himself. He retaliates, and the other person, unconscious of having done anything to evoke any hostility, finds *himself* affronted, and in *his* turn retaliates. By this time real grievances have come, and the quarrel is on. Balzac, that master analyst, in alluding to friendship, in one of his stories, says: "It died" (the friendship) "like other great passions—by a misunderstanding. Both sides imagine treachery, pride prevents an understanding, and [598] the rupture comes." Just as the malevolent feelings may arise *de novo*, so it is with the benevolent ones. Nordau shows how the nondescript state of being "in love" often arises. Some incident between John and Mary leads one of them—we will say John—to think mistakenly that Mary has been attracted to him. Pleased with

the fact, he reciprocates. Mary, altogether unconscious of the reciprocal nature of John's attention, finds pleasure in it, and in *her* turn reciprocates. Mutual reciprocity then follows.

In irritable persons we find the morbid sense of injury coupled with resentment. Quickly interpreting anything disagreeable to them as an affront by another, their first impulse is to resent it, which they do more or less violently, according to circumstances, their second thought often recognizing the irrational nature of the outbreak. This suggests the feral instinct. Examples are common in the lower animals, while in pain attacking those about them as if they were the cause of it. No doubt this resentment is a survival from evolutionary ancestry. It has probably served a necessary purpose in the conservation of animal life by causing the animal to attack what may, in the jealousy of self-preservation and its feeble discrimination, even be suspected of being inimical to its welfare. Blind and unjust, perhaps, but Nature hesitates at no apparent injustice to accomplish this. When we go higher, to the tribal relation of man, we find the same blind resentment. The Australian aborigines have no conception of death, except as vaguely associated with homicidal causes, and when a member of a tribe dies a most natural death a member of a hostile tribe is killed to avenge the supposed murder. The Africans, too, read homicidal forces into natural deaths. In civilized social relations it appears again in the very popular and usually irrational demand for a scapegoat when matters go wrong. The idea of religious sacrifice, too, is a practice by which the anthropomorphic God is credited with being aggrieved by human conduct and of wishing to be appeased therefor. Though the exercise of this indiscriminate resentment was probably greater and more necessary in the pre-social stage of human evolution, there is still ground for its activity to-day in the struggle for existence which has but changed its arena. Under a veneer of amity, laudable enough, there are till the suspicion and resentment of the tribal relation, as we may often see unveiled in a posse of boys, and that this resentment is yet of the blind kind, we still have proof if we have seen an enlightened man deliberately kick a harmless chair because he stumbled on it in the dark.

Phylogenetically, then, we see this morbid "sense of injury" to be [599] reversional. This is in harmony with the atavic theory of insanity. In the individual it is a delusion, and, like other delusions, an attempt by the reason to explain a disordered feeling; in this case a *painful* feeling, having its origin broadly in some imperfect adaptation of the organism. This attempt to explain a feeling or sensation seems a human necessity. However wide of the truth such explanations usually are, we seem forced to attempt them. In the case of this *painful* feeling, with which we are here concerned, we are either unwilling or unable to explain it in its true way, and are prone to attribute it to malevolent agencies, often personal—perhaps the "bogy-man" remnant of the child and race. Such explanation is often an easy escape from truths unwelcome to our ego—truths which, if recognized, would wound pride or conscience beyond easy endurance. It requires a man of rare courage and mental clarity to recognize his particular pain from failure in adaptation as autogenetic, and to lay it to natural and unflattering causes. We prefer, of the two, to accuse the environment rather than the organism, especially when the organism happens to be our own. We take refuge in a grievance rather than impugn the supremacy of our ego. Indeed, it seems to be necessary for healthy subjective activity, so to speak, that a sort of *imperialism* of the ego, however circumscribed, be maintained. It is the condition *sine qua non* of the necessary measure of well-being of the individual. It is most reluctantly relinquished, and we constantly see the plainest truths immolated that it be retained. Only in the great self-effacement of melancholia and in those rare characters who recognize and bear complacently naked truths—the *Weltschmerz* of Goethe—is this well-being renounced. Even those who are willing to father their own wounded ego still seek the necessary approbation by reducing its future pretensions or claims so that they may not be again pained by their failure to achieve them. They *unhitch* their wagon from the star. Professor James has illustrated this by a fraction showing that our approbation is determined by our *success* divided by our *pretensions*. Thus, $^{\text{success}}/_{\text{pretensions}}$ = approbation (self-esteem). The quotient may be increased by diminishing the *pretensions* or by increasing the *success*. James's fraction is as applicable to the moral conduct as to the intellectual side.

When we look for the physical equivalent of the mental state which evokes the "sense of injury" we find it in dynamic and toxic states of the nervous system and their correlation. Certain conditions of the individual or environment bring these into special relief. Old age is one. The querulousness, the sense of abuse or [600] persecution which afflict the aged and often lead them to take refuge in the martyr-spirit, are sad examples. The state of fatigue or exhaustion is another, and "neurasthenic" insanity is only an expression in greater degree of the morbid mental action found in fatigue and exhausted states.

The primary and secondary effects of alcohol or other narcotic indulgence is another soil in which the "sense of injury" easily grows. The *habitué* is notoriously suspicious and irritable, and full of fictitious grievances and unwarranted persecutory ideas. His attitude toward them is that of the paranoiac, vindictive, rather than that of the melancholiac, humiliated. They swell the army of so-called "borderland" cases of insanity, fretting their friends and puzzling the doctor with conduct alternately interpreted as "cussed" or "crazy."

Where there is bodily disease, acute or chronic, the morbid "sense of injury" is much in play. An intelligent patient, on recovery from a stomach disorder, admitted that whenever her stomach had ached she was taken with a violent hatred of her companion with whom she was in affectionate relation. An ignorant Southern colored woman, who had rheumatism in her ankle, believed that she had been "hoodooed," and explained the pain in her ankle by the presence of a snake, which she believed had been put there by a "hoodoo." She was not insane, the idea being consistent with her degree of intelligence, training, and early environment. Another patient, a sensible, cultivated woman, while suffering from a non-nervous illness, in which she had received all the consideration that love and money could furnish, believed herself to have been constantly and deliberately abused. After her recovery, now some years, she still maintains the belief. Instances could be multiplied, for doctors continually meet this atmosphere in the sick-room, from ugly little grievances to delusions of persecution. They are not surprised when a patient tells them in mingled confidence and complaint that he is hungry and neglected, that "they" will give him nothing to eat, etc., to find that his wife has been most attentive, has been pressing him to eat, and has stocked the pantry in anticipation. Dr. Johnson had plenty of ground for saying that a sick man is a rascal, though the modern doctor has reversed the formula.

Persons who suffer from actual trouble or ill treatment easily develop a morbid sense of injury, just as under similar conditions they may become insane. Unable to estimate the precise amount of their real grievance, there is an easy mental overflow into the fictitious ones. It is for this reason that the narrative of a real trouble or quarrel is so fraught with calumnious arraignment of [601] others that it is unreliable until we have heard the "other side of the story," and that when disputants meet and explanations follow they often find that they have no *casus belli*. In the examination of the alleged insane for commitment we have constantly to separate the real from the imaginary troubles. Mr. F—— was the subject of such examination. He was suffering from heart disease, and thereby compelled to remain at home idle. His wife was supporting the family by keeping boarders, and he began to develop a morbid jealousy of her. He annoyed her by a constant surveillance and suspicion of her every act, which amounted at times to the delusion that she was unfaithful to him, and which culminated one night in an outbreak in which the police figured. It was difficult to separate his real from his imaginary grievances, for his wife had ceased to have any affection for him, though his delusion in regard to her unfaithfulness was unfounded and had been grafted upon his real trouble. Sent to a general hospital, he improved, and was reported "not insane." Circumstances requiring a hard struggle for existence, disappointment without apparent cause, coupled with a certain sentimental cast of mind, often prevent the correct estimation of the wrongs suffered and the proper relation of undoubted misfortunes.

In the insane the sense of injury or its analogue—delusions of persecution—appears in numerous shapes. Thus patients are defrauded, or conspired against, or acted upon by witchcraft, magnetism, electricity, or poisoned, or preached against, or subjected to disagreeable odors. Sometimes the delusions are but ill-defined and vague. Often it is possible to trace them to their

underlying disordered sense impression or the particular environment or to vestiges of outgrown beliefs. They appear in depressed states of melancholia as well as in the exalted states of mania and paranoia. In melancholia they accompany a feeling of worthlessness which is the patient's explanation of his persecution—i. e., he is unworthy of better treatment. In paranoia the patient believes the persecution to be prompted by fear or envy of him, and there is consequently a feeling of self-importance—a morbid egotism which is in direct proportion to the magnitude or complexity of the ideas of persecution. Indeed, it is probable that these ideas of persecution, acting on a potentially melancholic or a potentially paranoiac mind, whatever these may be, determine the type that these mental diseases take.

The difference between the "injured" sense in the sane and insane states we must from our view point, without essaying to bridge all the *terra incognita* which lies between sanity and insanity, regard as largely but one of degree. And so with the underlying [602] mental and physical states. We find the morbid ideas more fixed in the sane than in the insane, frequent repetitions of the morbid impression tending to its final organization, so to speak. We also find that the morbid idea is usually more elaborated in the insane than in the sane state, although instances of the greatest elaboration are sometimes met with, especially where the element of some external foundation is large. It is probable, however, that the elements of fixity and elaboration of the persecutory idea are after all dependent upon and in proportion to the intensity of the underlying brain and mind states. In other words, that to increase a given intensity of these states is to increase the fixity and elaborateness of the "sense of injury," is to prevent the correction of the morbid idea, until finally exploited in conduct, which is the *début* of the insanity.

Thus the relativity of insanity which has all along been maintained is clear on the line here pursued. It would be equally so in following other lines of morbid psychology. It has, though, received but little general recognition, and writers still treat insanity as an entity apart from its bearings on the average mind and its evolutionary history. The word "insanity," or "lunatic," is no doubt largely responsible for this, suggesting popularly, as it does, a distinct class of persons—a type of being as unlike ourselves as a Martian might be fancied to be. Nature or science, however, has set no line between the morbid mental manifestations which constitute sanity and those which constitute insanity, that being an arbitrary, however practical, distinction which science has had rather to descend to meet. Nothing so stands in the way of the best welfare of the insane than this abysmal ignorance which still prevails in regard to them—an ignorance which still clings to the mediæval idea of insanity, the classical portraiture, as in the pictures of Hogarth, or on the stage, or in fiction; an ignorance which is ever hearkening for the maniac's shriek or the clanking of his fetters, which recognizes nothing short of "furious madness" as sufficient ground for committing a brain-sick man to the tender therapy of the hospital ward.

But those who know best tell us that the insane are very much like other people, that there is wonderfully little difference between them and ourselves; and sometimes but a slight circumstance, a mere accident of environment, determines which side of the hospital wall we shall be on.

[603]

EARLY EXPERIMENTS IN AIR FLIGHT.

By M. BANET RIVET.

Man has sought in all times and at all places to find means of leaving the earth's surface, in imitation of the birds, and rising into the air. Ancient legendary lore furnishes many stories, like those of Dædalus and his son Icarus, of attempts of this sort. In the fourth century B. C., Archytas of Tarentum, a learned Pythagorean, who has been credited with the invention of the screw, the pulley, and the kite, according to Aulus Gellius, constructed a wooden dove which could rise and sustain itself in the air by some mechanism the arrangement of which is not known. Credible accounts exist of an English Benedictine monk, Oliver of Malmesbury, in the eleventh century, having tried to fly by precipitating himself from the height of a tower, with the assistance of wings attached to his arms and his feet. It is said that, after having gone along a little way, he fell and broke his legs. He attributed his accident to failure to provide his apparatus with a tail, which would have helped preserve his equilibrium and made the descent a gentler one.

In the sixteenth century, Leonardo da Vinci first demonstrated that a bird, which is heavier than the air, sustains itself, advances in the air, "by rendering the fluid denser where it passes than where it does not pass." In order to fly it has to fix its point of support on the air; its wing in the descending stroke exerts a pressure from above down, the reaction of which from below up forces the center of gravity of its body to ascend at each instant to the height at which the bird wishes to maintain it. Some sketches that have come down to us prove that Leonardo occupied himself, like Oliver of Malmesbury, with giving man power to fly by the aid of wings suitably fixed to his body. We owe to Leonardo also the invention of the parachute, which he described in the following terms: "If a man had a pavilion, each side of which was fifteen braces wide and twelve braces high, he might cast himself from any height whatever, without fear of danger." It may be said, too, of Leonardo da Vinci, that he was the first to suggest the idea of the screw propeller. "If," he said, "this instrument in the form of a screw is properly made—that is, made of linen cloth, the interstices of which have been filled with starch—and if we turn it rapidly, such a screw will make a bearing nut for itself through the air and rise. This can be proved by moving a broad, thin rule rapidly through the air, when it will be found that the arm is forced to follow in the direction of the edge of the board. The frame for the cloth of which I have been speaking should be made of long, stout reeds. A model of it might be made in paper, with, for its axis, a thin strip of iron which we twist forcibly. When the strip is left free it will turn the screw."

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In 1680 Borelli published some studies of a remarkably correct character on the flight of birds. According to his view, the wing acts upon the air in the phase of beating down, in the manner of an inclined plane, so as, by virtue of the resistance opposed by the air, to push the body of the animal upward at first and then onward. The action of the ascending wing was compared to that of a kite, and it would consequently continue to sustain the body of the bird while waiting the following stroke. But Borelli never thought of turning his observations to advantage, so as to supply man with the means of flying. Attention was much engaged in 1742 with the attempt of the Marquis de Bacqueville, substantially repeating that of Oliver of Malmesbury, which was terminated by a similar accident. Mention should also be made of Paucton, who in 1768 drafted a plan for a screw machine. In 1784 Launoy and Bienvenu exhibited and operated, before the Academy of Sciences in Paris, a screw which was moved by a strong spring. Before this, however, Joseph and Stephen Montgolfier had filled the world with the noise of their discovery of the air balloon, and the ingenious machine of these aëronauts failed to receive the attention it deserved.

It has been known since the days of Archimedes that every body partly or wholly submerged in a liquid in equilibrium suffers a vertical push upward from the fluid equal to the weight of liquid it displaces.

Let us consider the case of a body entirely plunged in a liquid—water, for example. If its weight exceeds the thrust it suffers it will fall to the bottom of the water under the action of a descensional force equal, at each instant, to the difference between the weight of

the body, which is invariable, and the thrust, which is invariable also, and thus constant in direction and also in amount. If the weight of the body is less than the thrust, the latter overcomes it, and, contrary to the usual laws of weight, the body will rise under the action of an ascensional force, which will evidently be likewise constant in amount as well as in direction. A cork held down at the bottom of a vessel of water and then left to itself will supply an example of this ascensional movement.

A third case may be presented—that in which the weight of the body is equal to the thrust of the water. Weight and thrust are then in mutual equilibrium. No force invites the body either to descend or to rise, and it remains balanced in the midst of the liquid, wherever [605] it happens to have been placed. This state of indifferent equilibrium is, however, possible only if the weight of the body remains rigorously constant. The slightest augmentation of the weight immediately causes the body to descend, while the slightest diminution sends it up. From this source arise the difficulties that are met in the construction of submarine boats, when their ascent or descent is obtained by means of air chambers, which are filled with water or emptied of it according to the requirements. The equilibrium of these engines is always precarious, and this explains why none of them, from that of Van Drebbel in 1620 to the experiments of Goubet in 1895, have given really practical results in the matter of stability of immersion.

When Galileo, following Aristotle, had demonstrated the ponderability of the air, and Torricelli had proved that atmospheric pressure was a result of that property, it was immediately thought that the principle discovered by Archimedes might be extended to the air, and Otto von Guericke gave an experimental demonstration of it by the invention of the baroscope.

From this period it seems, then, that the discovery of aëronautics was possible. If the weight of the volume of air displaced is greater than that of the body, the latter should take an ascensional movement in the atmosphere, as a cork does when plunged into water; and it is evident that for a body to satisfy such conditions we have only to fill a very light envelope with a gas less dense than the ambient air. But the study of gases was still in its infancy in the seventeenth century, and it required the labors of Mortrel d'Élement and Hales, at the beginning of the following century, to teach physicists how to collect and retain them.

The history of the progress of the human mind shows, further, that the pure and simple acceptance of a scientific discovery is not enough to make it produce all the consequences we have a right to expect from it. It must, further, impregnating the mind with itself, pass, we might say, into the condition of an innate idea. Chemistry, in this very matter of the discovery of the weight of the air and of the gases, presents a striking example of the accuracy of our proposition. The ponderability of the air had been accepted by physicists for a long time, while chemists continued to take no account of it, although, as Mendeleef has remarked, no exact idea could be conceived, under such conditions, concerning most chemical phenomena. It is to the glory of Lavoisier that he first took account of this ponderability and of that of all the gases as well. When we reflect that it was not till about 1775, or a hundred and fifty years after Galileo, that this illustrious Frenchman began to set forth those ideas, it is not any wonder that the discovery of [606] aërostats was not made till toward the end of the eighteenth century. Lalande was therefore much in the wrong when he said "it was so simple! why was it not done before?"

It would not be just, however, to refer the discovery of aërostats solely to the efforts of the Montgolfiers. Like all inventors, like Lavoisier himself, these brothers, as Figuier has remarked, had the benefit of a long series of isolated labors, carried on often without special purpose, by which the elements of their invention had been gathered up.

Père Lana, of Brescia, conceived a plan in 1670 for constructing a ship which should sustain itself in the air and move by the aid of sails. Four copper globes, in which a vacuum had been produced in order to render them lighter than the volume of air displaced, were to support the ship while the sails propelled it. The scientific conception of the empty globes was correct, but Père Lana did not think of the enormous collapsing force which the atmospheric pressure would exercise upon them. The idea of a sail which would give his aërial boat a resemblance to a vessel driven by the winds

was wholly erroneous.

Sixty-five years later, in 1735, Père Galien, of Avignon, gave a fairly clear expression to the theory of aërostats. Resting on the principle of Archimedes, he maintained that if he could fill a globe made of light cloth with a sufficiently rarefied air the globe would necessarily possess an ascensional force, which would permit it to lift itself up in the air with a ship and all its cargo. He proposed to draw this rarefied air from out of the upper regions of the atmosphere, down from the summits of high mountains, forgetting that the air, when brought down to the level of the ground, would contract in volume and assume the density of the ambient atmosphere.

In the condition of ignorance of the properties of gases that existed in that age, it did not occur, and could not have occurred, to Père Galien to use other gases than air; no more could he have thought of employing heat to rarefy the air, for the first not very precise notions on the decrease in densities of gases by heat only date from Priestley. But when Cavendish, in 1765, had fully studied hydrogen gas, and shown that as it was prepared then it was seven times lighter than air, Black was enabled to suggest that by filling a light bag with hydrogen the bag would be able to raise a certain weight in the air. The labors of Cavendish, Black, and the discoveries of oxygen, nitrogen, and other gases by Priestley, were described by Priestley a few years afterward in the celebrated book on The Different Kinds of Air—a book which Stephen and Joseph Montgolfier had in their possession. The two brothers evidently found the germ of their invention in it. [607]

It is fair to say that the Montgolfiers, who were already known in the learned world by their discoveries in the mechanical sciences, had thought, before they knew of Priestley's book, of a way of imitating Nature by inclosing vapor of water, a gas lighter than air, in a paper bag, which would be lifted up, the vapor contained in the bag being sustained in the air like a cloud. But the vapor condensed, and the weighted balloon shortly fell to the ground. The smoke produced by burning wood inclosed in a bag gave no better results. After seeing Priestley's book, they substituted hydrogen for vapor and for smoke, but the gas passed through the paper bag, and they gave up this attempt.

They then fancied that electricity was one of the causes of the rise of clouds, and sought for a gas that had electrical properties. They thought they could obtain it by burning wet straw and wool together. A box made of silk was filled with this gas, and they had the great satisfaction of seeing it rise to the ceiling of their room, and, in a second experiment, into the air. This was in November, 1782.

Five months previously, Tiberius Cavallo, in England, had repeated Black's experiment of filling a paper sack with hydrogen; but, as the Montgolfiers had found, the hydrogen leaked through the paper. Cavallo had better success with soap bubbles, which held the gas. His experiments stopped here, while the Montgolfiers carried theirs on to practical success.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

SKETCH OF EDWARD ORTON,

LATE STATE GEOLOGIST OF OHIO; LATE PRESIDENT OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

All persons interested in American science were surprised and shocked at learning of the death, from heart trouble, on October 16, 1899, of Prof. Edward Orton, of the Ohio State University. The event occurred only little less than two months after Professor Orton had presided, with a simplicity of manner that did not hide but rather heightened the traits of vigor in his character, over the meeting of the American Association for the Advancement of Science at his home in Columbus, Ohio. The services he rendered to geology, his long and honorable career as an educator, and his continual and consistent insistence upon the faithful use of the scientific method well entitle him to be remembered as one of the most meritorious of American scientific workers.

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EDWARD ORTON was born in Deposit, Delaware County, N. Y., March 9, 1829. He was descended from Thomas Orton, who, born in England in 1613, was one of the fifty-three original settlers and owners of Farmington, Conn., was of the stock from which most of the Ortons in the United States are derived, and represented his town in the General Court in 1784. Another ancestor, a grandson of Thomas Orton, was one of the original purchasers and settlers of Litchfield, Conn., where he owned a square mile of land known as Orton Hill, on the south side of Bantam Lake. Two of the maternal ancestors of the subject of this sketch fought in the colonial wars, and ten Ortons were soldiers in the Revolution.

Young Edward Orton was taught by his father, the Rev. Samuel G. Orton, D. D., and received further training preparatory for college in the academies of Westfield and Fredonia, N. Y. He entered Hamilton College, whence his father had been graduated in 1822, in 1845 as a sophomore, and was graduated in 1848 in a class among the other members of which were the Rev. Dr. Thomas S. Hastings, President of Union Theological Seminary, New York, and the Hon. F. J. Van Alstyne, afterward Mayor of Albany, N. Y., and member of Congress. After his graduation he taught for a number of years in academies at Erie, Pa., Franklin, N. Y., and Chester, N. Y., and became, in 1856, Professor of Natural Science in the State Normal School at Albany, N. Y. He pursued post-graduate studies in chemistry, botany, and other subjects at the Lawrence Scientific School, with Professors Horsford, Cooke, and Gray as his teachers, and studied theology for a time under Dr. Lyman Beecher, at Lane, and Dr. Edwards A. Park, at Andover Seminaries. While teaching at Chester, N. Y., he was called to Antioch College, Yellow Springs, Ohio, where he took charge of the preparatory department in 1865; was made Professor of Natural History shortly afterward, and was made president of the college in 1872, but retained the office for only one year, at the end of which he went to occupy a similar position in the State University at Columbus.

When the second Geological Survey of Ohio was undertaken in 1869 under the charge of Prof. J. S. Newberry, Professor Orton was appointed an assistant by Governor Rutherford B. Hayes, and was continued by reappointment by Governor E. F. Noyes. When Professor Newberry withdrew from the survey in 1881, Professor Orton was appointed State Geologist by Governor Charles Foster, and he was afterward reappointed to the position successively by Governors Hoadley, Foraker, Campbell, and Bushnell. He retained the title of State Geologist till his death, although he had not been engaged in any active public work on the survey for a considerable time.

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The Ohio State University having been established on the basis of the grants of land made to the States for colleges under the Morrill Land-Grant Act, Professor Orton was appointed its president and Professor of Geology. He discharged the duties of this office for eight years, or till 1881. But the executive work of the president's office was irksome to him, since it grew constantly heavier as the young college expanded, and therefore left him less and less time for teaching and research in geology. Being in a measure compelled to make a choice between the two fields of activity, he chose the less ambitious position, resigning the presidency, and assuming the position of Professor of Geology, which he retained for the remainder of his life. The geological building of the university is named after him—Orton Hall. Besides his work on the Geological

Survey of Ohio and his participation in the composition of its reports, Professor Orton prepared, for the Eighth Annual Report of the United States Geological Survey, a paper on the New Oil and Gas Fields of Ohio and Indiana, and another, only recently published in the Nineteenth Annual Report of the United States Survey, on the Rock Waters of Ohio; a volume for the Geological Survey of Kentucky on the Petroliferous Production of the Western Part of the State, published in 1891; and a report on petroliferous productions which is in process of publication by the Geological Survey of New York.

In the paper on the Oil and Gas Fields of Ohio and Indiana the discovery of the supply of those materials, the great value of which was only realized in 1884 and afterward, is spoken of as being more surprising and anomalous than any similar discovery that had preceded it, and as a development which experts were hardly more prepared for than others. The oil and gas derived from the Trenton limestone in certain parts of these States were found to differ from the oil and gas in the Pennsylvania wells in chemical composition and physical properties, in the horizons from which they were obtained, in the structural features of the rocks associated with their production, and, most of all, in the kind of rock that produced them. "No facts more unexpected have ever been brought to light in connection with the geology of this country than those with which we are now becoming acquainted." Professor Orton's paper, which fills one hundred and eighty of the large pages of the report of the Geological Survey, includes a sketch of the history of the discovery to July, 1887, when it was prepared; a designation of what was known in regard to the geological scale and geological structure of [610] the regions within which the new fields are embraced, and the tracing of the chief factors that influence or control the productiveness of the oil rock, with the description of the special features and boundaries of the several fields and the setting forth of the leading facts and present development of these lately found sources of power. Two principal conditions under which the new oil rock had proved petroliferous on a large scale were found to be porosity, connected with and apparently dependent on the chemical transformation of the upper portion of the limestone, for a number of feet in thickness, into a highly crystalline dolomite; and a relief resulting from slight warping of the strata, whereby the common contents of the porous portions of the Trenton limestone had been differentiated by gravity, the gas and oil seeking the highest levels, and the salt water maintaining a lower but definite elevation in every field. Professor Orton found nothing in the new experience to make it safe to count the Trenton limestone an oil rock or a gas rock in any locality, unless it could be shown to have undergone the dolomitic replacement by which its porosity was assured; and even in case it had suffered this transformation it would not be found a reservoir of gas or oil in an important sense unless some parts of it had acquired the relief essential to the due separation of its liquid and gaseous contents.

The report on the Rock Waters of Ohio concerns, first, those waters, chiefly in the northwestern and western part of the State, that are obtained from a considerable depth as compared with ordinary wells, the knowledge of which was almost wholly derived from wells drilled in the search for oil and gas, and was necessarily fragmentary and incomplete; because water was not included among the objects of search, but was considered a hindrance and obstruction to be got out of the way as well as possible; and, second, flowing wells, including only those having considerable head of pressure and those occurring in considerable areas, all of which belong entirely to the drift. Further, a brief review is given of some facts of unusual interest that were developed in the deep drillings concerning the preglacial drainage system of the part of the State in question. Indications of old river channels, one of which seems to have been extensive, were found at several points. Among the curious results of these studies was the conclusion, "seeming to be already established," "that the Ohio River, as we now know the stream, is of recent origin, and that the main volume of water gathered in it at the present time originally flowed across the State to the northward at least as far as Auglaize and Mercer Counties, where it turned to the westward toward the present lines of Wabash drainage in Indiana." Professor Orton seems to have placed [611] considerable emphasis on the value of a study of the rocky floor of the State, concerning which all we know at present is derived from

the revelations of deep drillings at haphazard; and he thought it would be a good work for the State to make use of all accessible data of this kind at once in constructing a model of the rocky floor of the region under review. The care and fidelity with which he studied the underground geology are exemplified in a map attached to the paper on the oil and gas fields, in which the horizons of the Trenton limestone are indicated and approximately bounded as they occur by gradations ranging from fifty to two hundred and fifty feet, from elevations above the ocean level to one thousand and more feet below. Another contribution of Professor Orton's which may appropriately be given special notice is his part of the article on Ohio in the Encyclopædia Britannica, in which a succinct, clear, and comprehensive account of the geology of the whole State is given, with its salient features delineated so sharply that one may almost conceive from it a definite geological picture of the region.

Of all his scientific work, however, Professor Orton regarded the fixing of the order of the coal measures of Ohio as the most important; and he considered the determination of the order of the subcarboniferous strata, and particularly of the Berea Grit, as constituting a large permanent service to the study of the geology of the State.

At the recent meeting of the American Association for the Advancement of Science Professor Orton contributed a special paper on the local geology of Columbus, the place of the meeting, in which he dwelt largely on the origin of the drift that marks the superficial geology of the vicinity.

Of the work he has done for the increase and advancement of knowledge, the extent of a part of which we have only faintly indicated by the mention of a few particular researches, Professor Orton put the highest value on his labors as a teacher, a calling to which he was devoted for more than half a century. He found peculiar pleasure in instructing the children of the old pupils whom he had taught in his younger days. He was actively concerned in the promotion and extension of sanitary science, his addresses in that field having been one of the factors that led to the establishment of the Ohio State Board of Health. He was also greatly interested in the advancement of agriculture.

A theme on which Professor Orton was fond of dwelling in his public addresses was the amount and value of what has been accomplished within a comparatively short time in the world's history by the use of the methods of science. In an address delivered before the alumni of Hamilton College in 1888 he maintained that [612] we were living in a revolutionary period, which is marked by a great advance in knowledge and a vastly larger control of the forces of Nature; by a large increase in freedom of thought and action; by a sudden and remarkable addition to the mobility of man, accompanied by an unexampled growth of great cities; and by an incalculable addition to the wealth of the world. Accompanying these great changes in the material and intellectual world were certain moral transformations appearing to grow out of them. All these advances were ascribed to a movement—a new method of investigating Nature—that began, so far as its particular and continuous development is concerned, about three hundred years ago, but to which no date or founder's name could be attached. This new philosophy thoroughly respected Nature, was humble, patient in the accumulation of facts and the trial of its theories, comprehensive, progressive, and hopeful. It has given us the marvelous increase of knowledge which especially marks the nineteenth century; it has impressed its influence upon all branches of study, and has wrought great improvements in methods and results; and has rendered an immense and inestimable service to Christian theology, and done much to broaden and rationalize it and thus to perpetuate and strengthen its hold on the world. Finally, the method of science was pronounced "the best gift that God has given to the mind of man." A similar train of thought as to the material aspects is apparent, though in a somewhat different form, in an address on The Stored (or Fossil) Power of the World, delivered in 1894.

A considerable part of Professor Orton's presidential address at the last meeting of the American Association was devoted to a summary of the conclusions derived from Alfred Russell Wallace's book, The Wonderful Century, that the progress accomplished in the present century far outweighs the entire progress of the human race from the beginning up to 1800. In this address, also, the author

felicitously spoke of the scope of the American Association as possibly including the whole continent, and its object as the advancement of science, the discovery of new truth. "It is possible that we could make ourselves more interesting to the general public if we occasionally forswore our loyalty to our name and spent a portion of our time in restating established truths." But the discoveries recorded, though often fragmentary and devoid of special interest to the outside world, all had a place in the great temple of knowledge; and the speaker hoped that although no great discoveries should be reported this time, the meeting might still be a memorable one through the inspiration it would give to the multitude of workers in the several fields of science.

Professor Orton was a member of several learned societies; was [613] President of the Sanitary Association of Ohio in 1884 and 1885; received the degree of Ph. D. from Hamilton College in 1876, and that of LL. D. from the Ohio State University in 1881; was elected President of the Geological Society of America in 1896; and was designated at the Boston meeting of the American Association, 1898, as president for the Columbus meeting, 1899.

In addition to his interests in science and theology, Professor Orton was keenly alive to everything that bore on the history of man on this planet. He was long a member of the Ohio State Archæological and Historical Society, and had recently been made a member of its board of trustees. He was a prominent member of the Old Northwest Genealogical Society, and was the author of a volume, published in 1896, on the Genealogy of the Orton Family in America. The absolute freedom of his character from any desire for display or self-aggrandizement is well shown by the fact that in this volume, compiled, with enormous labor, in the spare minutes of a busy life, he cuts himself off with one paragraph of a hundred words, while devoting pages to contemporaneous members of the family of whom the world has never elsewhere heard.

He was stricken with hemiplegia in December, 1891, but was able to do a considerable amount of work in his profession afterward. A few days before his death he said, in a note, that he felt that he had lived out his allotted time, and that his work was done. He never met his classes again, though he continued able to be up and about his home till the hour of his death. He seemed to feel that the solemn event was drawing close, during the last two days of his life, and his mind was always busy with the great question, "If a man die, shall he live again?" He had formed an affirmative answer apparently, as he read Browning's Prospice repeatedly in his last hours, and seemed to find in it the greatest pleasure and solace. His death was a quiet and painless one—a fitting end to a beautiful life.

Statistics of cremation, presented by M. Bourneville at the recent annual meeting of the society in Paris, show that the number of incinerations at the Père Lachaise crematory has almost steadily increased since 1889, and that the whole number last year was 4,513, making 37,068 from the beginning. A fair proportion of the number were women. There are now in Europe and America seventy crematories, twenty-seven of which are in Italy and twenty in the United States. Cremation is making good progress in England, where four crematories are reported from, and two are in course of erection. Germany has six, where 423 incinerations took place in 1898; Switzerland and Sweden have two each, Denmark one, and one has been authorized in Norway.

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Editor's Table.

A COMMISSION IN DIFFICULTIES.

The synopsis which has been given to the press of the Thirteenth Annual Report of the Interstate Commerce Commission is not encouraging reading for those who like to believe in legislation as an infallible panacea for all public and social ills. The tone of the document indeed is very far from being one of triumph. The note struck in the very first paragraph is the need for more legislation to save the copious legislation already passed from proving ineffectual and abortive. Whether it is that Congress does not wish to make the work of the commission successful, or whether it has begun to have a wise distrust of its own powers, we can not say; but the commissioners complain bitterly of its inaction. We can not do better than quote their own words: "The reasons for the failure of the law to accomplish the purposes for which it was enacted have been so frequently and fully set forth that repetition can not add to their force or make them better understood. It is sufficient to say that the existing situation and the developments of the past year render more imperative than ever before the necessity for speedy and suitable legislation. We therefore renew the recommendations heretofore made, and earnestly urge their early consideration and adoption."

As the document proceeds, we see the good commissioners at war with the wicked railways, and it is impossible to resist the conclusion that, on the whole, the wicked railways have the best of it. The commissioners admit that certain cases which have come before the courts have been decided against them, and in favor of the railways; but they are far from disclosing the full extent of the discouragement, not to say mortification, they receive. The business of the commission is to interfere between the railways and their customers—the public—in the interest of the latter. The railways naturally consider this a rather one-sided function, and are not extremely zealous to aid in its performance. They have their own troubles with the public, and have no commission to come to their assistance. Everybody is after cheap railway rates, just as everybody is after cheap goods; and the means sometimes resorted to to get reductions would at least hold their own for astuteness with any that could be concocted in a traffic office for the raising of rates. We give the commissioners full credit for doing their best to protect the interests of the public, but we can not help doubting whether, on the whole, the public has derived much benefit from their efforts. In fact, we are strongly inclined to the opinion that the whole idea of the commission is simply a legislative blunder.

The railways undoubtedly possess great powers which theoretically there is nothing to prevent their abusing to almost any extent. But what is theoretically possible is not always practically possible. The President of the United States possesses great powers, which theoretically he might abuse to any extent; so does the Queen of England; so do many other potentates. But of all the evil that is theoretically possible, how much is carried out in practice? All kinds of things *might* happen if people were fools enough to do all the harm that it is in their power to do. The great saving fact is that it is not possible to go very far in doing harm to others without doing it [615] to yourself. It is this fact which the insatiable legislation-monger ignores. He has an infinite faith in the mischief that will happen if things are left alone. He can not bear to think that somebody is not looking after everybody. He has no faith whatever in natural law or natural actions and reactions, and would hoot the idea of what the poet Wordsworth calls a "wise passiveness." Such people have little conception of the mischief they do, and of the good that fails of realization through their pestilent activity. The readers of Dickens will perhaps remember Mrs. Pardiggle and the admirable system of education she applied to her numerous family of children. The unhappy youngsters were under orders every hour of the day; they were marched round the country with their mother when she went on visits of charity, and compelled to contribute out of their own (nominal) pocket money to all kinds of religious and benevolent schemes. How they kicked and rebelled, and what distressing passions were roused in their youthful breasts, the great novelist has told us; and we think we may take his word for it. The fussy legislator is a Pardiggle. If he would leave things alone, opposing

interests would find a *modus vivendi*, and practical justice would more and more assert itself. The more interference there is between parties who in the last resort are dependent on one another's good will, the less likely they are to recognize their substantial identity of interest. If the interference is wholly in the interest of one of the parties, the other is sure to be forced into an undesirable attitude; while the one whose protection is the object in view will not unnaturally take all the protection he can get, and look for something more.

What is wanted to put the relations between the railways and the public upon the most satisfactory footing possible is, in the first place, less legislative interference; and, in the second, a higher tone of business morality throughout the community. We place this second not as underrating its importance, but because we believe it would to some extent flow from the first. It is when the public transfers its right of eminent domain to a railway corporation that it should take adequate measures to protect its own interests; but how can this be done when legislation is sold—when charters are given or withheld, according to the amount of money available for purposes of persuasion? With honest legislators and honest courts there would be very little trouble between the railways and the public, and such as arose could be easily remedied. Commerce commissions are a testimony to the existence of low standards of business morality; and, unfortunately, they tend to keep them low, if not to make them lower.

The sooner we make up our minds to trust more to moral influences freely acting in the intercourse of man with man and of interest with interest, and less to legal compulsion, the better it will be for us in every department of our national life. The Thirteenth Annual Report of the Interstate Commerce Commission is a virtual confession of the failure of legislation to accomplish a purpose which was supposed to be easily within its field of action. The confession is coupled with a demand for more legislation, but, were the demand conceded, who can guarantee that more still would not be wanted? The railways are not at the end of their resources, and new laws would, we fear, be only too likely to suggest new means of evasion. No; the remedy lies elsewhere, and if Congress is wise it will give that remedy a trial by allowing the railways and the public a chance to arrange terms between them, with public opinion as the principal court of appeal. [616]

THE FUNCTION OF THE PUBLIC LIBRARY.

A paper that was read by Mr. Lindsay Swift, of the Boston Public Library, at a meeting of the Massachusetts Library Club, on the subject of Paternalism in Public Libraries, and which we find in the Library Journal for November last, is one which, in our opinion, deserves to be separately printed and widely circulated. It abounds in good sense, and preaches a doctrine of self-help and self-reliance which is much needed in these days.

A question which the author of the paper does not discuss, but which, it seems to us, lies at the threshold of the whole subject, is whether the very existence of a public library—if we understand by the term a library supported by public taxes—is not in itself an exemplification of paternalism. Mr. Swift strikes us as a benevolent bureaucrat who wants to give the people at large a wider liberty in the matter of reading than the ruling influences of time and place are disposed to allow. He sees that liberty is good, that leading strings belong to infancy, and he raises his protest against a paternalism in the management of public libraries which, under the plea of providing only the most approved reading for all classes, would tend to the repression of individuality in the reader and the establishment of the supremacy of commonplace. But what if commonplace insists on being supreme and shutting out whatever is not of one complexion with itself? How are we to resist its demand in the administration of a State-supported, and therefore majority-ruled, institution? "You offer us," say its representatives, "a liberty we do not want for ourselves, and are not prepared to concede to others, as we are sure it can not be for their good. We are not going to consult the tastes of cranks, criminals, intellectual aristocrats, or social mugwumps of any kind. For all practical purposes we are the public, and we mean to run this public library." To the objection that

a portion, at least, of the taxes is paid by those whose views and tastes are not going to be consulted, the answer would be ready: "It is for the majority to say how taxes shall be applied." We recognize the excellence of Mr. Swift's intentions and sympathize with his way of looking at things, but we feel that his objections to "paternalism" in connection with public libraries are delivered from a somewhat shaky platform. We observe that a periodical quoted in the Library Journal—the Overland Monthly—makes the remark that "there is nothing to be said for free books that could not be urged in favor of free beefsteaks and free overcoats."

Some of the points, however, that are made by Mr. Swift are deserving of attention. The several professions—law, medicine, theology, etc.—would more or less like to have only such books placed upon the shelves of a public library as represent what may be called their respective orthodoxies. But, as Mr. Swift observes, "libraries are as much the depositories of the folly as of the wisdom of the ages." A library, therefore, should tell us what men have thought and attempted in the past, and what they are thinking and attempting now. It is for schools and colleges, for newspapers and reviews, to afford guidance in the wilderness of opinions, not for the library to make a point of putting out of people's reach everything that is not in line with the scientific, literary, or other orthodoxy of the hour.

"A subtle form of paternalism is the deliberate inculcation of the patriotic spirit, especially in children." Mr. Swift is a brave man to attempt to stem this particular torrent. He thinks there are times when one who loves his country would feel shame for it rather than pride, and that the motto "My country right or wrong" is not the most wholesome sentiment that can be impressed on the mind of youth. "To fill a child with the consummate virtues of Washington, Jefferson, and other of our immortals, and to leave him ignorant of the greatness of Cromwell and of William the Silent, is a serious injustice to the child and to the cause of education." Not only is this done, but, in the domain of literature as well, it seems as if the only names with which public-school pupils obtain any acquaintance are those of national authors. So far as poetry is concerned, Mr. Swift says that almost the only name he hears from the lips of children frequenting the Public Library is "Longfellow." He can not remember ever having had a call from a child for Tennyson, while Wordsworth in the school region is equally unknown. [617]

Apart from the studied inculcation of a narrow patriotism, the author of the paper we are considering thinks that there is altogether too much paternalism shown in the choice of children's reading. He has only a limited and feeble faith in "children's rooms" in public libraries. They are very much, he thinks, like Sunday schools—convenient places for parents to unload their offspring. The aim of the censorship is to eliminate everything that is not in accord with the most approved canons of juvenile life and thought, leaving only what is ready for immediate acceptance and assimilation. Such a policy, Mr. Swift holds, is not favorable either to individuality or to intellectual growth. "We must," he says, "take books, like life, as we find them, and learn to distinguish good and bad; learn, as we ought, that the good is not so good as we have been told it is, and that the bad contains a strong infusion of good. No wrecks are so fearful as those which come to the young who have up to a point led 'sheltered lives.'"

It is not, however, children only who get the benefit of a benevolent protective policy. Selecting committees are quite prepared to look after grown-up people as well, and keep out of their way books which might prove too exciting, which might reveal depths of passion such as persons leading decorous lives are not supposed to know anything about, or otherwise agitate the tranquil mill pond of their existence. It does not occur to them that thus the salt and savor of human life are expelled, and that, instead of the free play of vital forces, there supervenes a dreary mechanic round of semi-automatic activities unvisited by enthusiasm, untouched by strong desire, without dream or vision or any quickening of the heart or the imagination. Some good people are excessively particular not only as to what may threaten moral disturbance, but as to anything that may encourage departures from conventional modes of speech and deportment. They do not like to admit books that they regard as vulgar, and a great mark of vulgarity in their opinion is the use of slang. Yet so accomplished a *littérateur* as Mr. William Archer told us lately that he pleads guilty to "an unholy

relish" for the talk of "Chimmie Fadden" and his Chicago contemporary "Artie." To him, as to Mr. Swift, the books in which these worthies disport themselves *mean something*, and something deserving of attention. That being the case, the vulgarity, which is part of the picture, becomes in proportion to its truth an element of value. Mr. Swift, very bold and like the ancient prophet, says plainly: "Harmless books in general are mediocre books; if a new note in morals or society is struck, the suggestion of a possible injuriousness at once arises." [618]

Taken as a whole, Mr. Swift's paper is a strong plea for individualism and liberty. As such we have felt it a duty to call attention to it, and we trust that it will in some way obtain a more general circulation than can be afforded by the useful, but somewhat technical, columns of the Library Journal.

Fragments of Science.

Longevity of Whales.—Some light was thrown, a few years ago, upon the subject of the vitality of whales by finding one of these animals in Bering Sea, in 1890, with a "toggle" harpoon head in its body bearing the mark of the American whaler Montezuma. That vessel was engaged in whaling in Bering Sea about ten years, but not later than 1854. She was afterward sold to the Government, and was sunk in Charleston Harbor during the civil war to serve as an obstruction. Hence, it is estimated, the whale must have carried the harpoon not less than thirty-six years. In connection with this fact, Mr. William H. Dall gives an account, in the National Geographic Magazine, of a discussion with Captain E. P. Herendeen, of the United States National Museum, of cases of whales that have been supposed to have made their way from Greenland waters to Bering Strait, and to have been identified by the harpoons they carried. While it is very likely that the whale really makes the passage, an uncertainty must always be allowed, for ships were often changing ownership and their tools were sold and put on board of other vessels, and harpoon irons were sometimes given or traded to Eskimos. It therefore becomes possible that the animal was struck with a second-hand iron.

Solidification of Hydrogen.—As soon as he was able to obtain liquid hydrogen in manageable quantities, in the fall of 1898, Mr. James Dewar began experiments for its solidification. The apparatus he used was like that employed in other solidification experiments, consisting of a small vacuum test-tube, containing the hydrogen, placed in a larger vessel of the same kind, with excess of the hydrogen partly filling the circular space between the two tubes. No solidification was produced, and the effort was suspended for a time, while the author attacked other problems. The experiments were renewed in 1899, with the advantage of more knowledge concerning reductions of temperature brought about by reduction of pressure. A slight leak of air in the apparatus was observed, which was frozen into an air snow when it met the cold vapor of hydrogen coming off, and this leak at a particular point of pressure caused a sudden solidification of the liquid hydrogen into a mass like frozen foam. An apparatus was then arranged that could be overturned, so that if any of the hydrogen was still liquid it would run out. None ran out, but by the aid of a strong light on the side of the apparatus opposite the eye the hydrogen was seen as a solid ice in the lower part, while the surface looked frothy. The melting point of hydrogen ice was determined at about 16° or 17° absolute (-257° or -256° C.). The solid seemed to possess the properties of the non-metallic elements rather than of the metals, among which it has been usual to class hydrogen.

The Gegenschein.—Much interest prevails among astronomers at present concerning the question of the nature of the *Gegenschein*. This German word, which means "opposite shine," is applied to designate a small, somewhat oblong, bright spot which is sometimes seen in the sky at night, nearly opposite the point which [619] is at the time occupied by the sun on the opposite side of the globe. It is near the ecliptic, but appears two or three degrees away from exact opposition to the sun. It seems agreed that the *Gegenschein* is not atmospheric, but rather meteoric, being a reflection from some collection of meteors. The problem set before astronomers is to identify the meteors. A theory that they are connected with the asteroidal zone, or mass of meteors of which the known and numbered asteroids are conspicuous examples, has, according to Professor Barnard, "much in its favor, but there are objections to the theory which can not easily be reconciled with the observed facts." Mr. J. Evershed, of Kenley, England, assumes the *Gegenschein* to be a tail to the earth, produced by the escape of molecules of hydrogen and helium away from the globe in a direction opposite to the sun—much as a comet's tail is formed. Other observers suppose it to be connected with the zodiacal light or band, which is regarded as a body of meteors connected with the earth and accompanying it, and is plainly visible in the western sky after sunset in the spring, rising from the place of the sun toward

the zenith; and Mr. William Anderson, of Madeira, publishes a figure with a demonstration, in The Observatory, to show how its place and appearance may be accounted for on this supposition. The *Gegenschein* has been compared in a homely way to the radiance which may be seen around the shadows of our heads cast by the sun upon the dewy grass early on a bright summer morning.

Literature for Children.—Mr. Richard le Gallienne, in an article published in the Boston Transcript, laments the flood of rubbish that is poured out under the guise of children's books. The subject of literature for children is discussed in the Studies of the Colorado Scientific Society by Prof. E. S. Parsons, who remarks that three of the greatest classics of childhood were not written for children at all. "Pilgrim's Progress was a new type of sermon written by the tinker preacher in his prison cell at Bedford; Robinson Crusoe was a pseudo-history from the pen of one of the first great English realists; Gulliver's Travels was a political satire by the greatest of English satirists. The same thing is true of the stories of the Bible, of the Arabian Nights, of the folklore which strikes a sympathetic chord at once in the child's nature.... Child study, then, reveals the fact that the child nature is the counterpart of what is best in books—that children can appreciate literature." A friend of Professor Parsons wrote him of her daughter, nine years old, being very fond of her father's library, and "simply devoted" to the Bible and the plays of Shakespeare. Harriet Martineau, when a child, "devoured all of Shakespeare," sitting on a footstool and reading by firelight, and making shirts, with Goldsmith or Thomson or Milton where she could glance at them occasionally. Another of Professor Parsons's friends read "all of Goethe's Faust with his little thirteen-year-old girl, to her great enjoyment," and the little girl afterward read alone all of Chaucer's Canterbury Tales. "Many teachers have found young children delighted with Dante." These incidents and others point to the inference that it is not necessary to go outside of the world's great literature for fit material for a child's imaginative and emotional nature. One of Mr. Le Gallienne's main conclusions is that it is very hard to guess beforehand what the child will like.

Geography and Exploration in 1899.—No great geographical discoveries were recorded during 1899, but much good work was done in exploration. Considerable interest has been taken in preparing expeditions of antarctic research, of which a Belgian expedition has returned with some important results, and Mr. Borchgrevink has begun work at Cape Adar, on the antarctic mainland. The search for Andrée has helped increase our knowledge of parts of the arctic coast. In Asia, Captain Deasy has laid down the whole of the before unknown course of the Yarkand River, and has furnished other information concerning little-known regions; and other surveys and explorations have been diligently prosecuted. About as much may be said of Africa, where "the want of adequate exploration of the mountainous regions on the borders of Cape [620] Colony and Natal has been only too forcibly brought home" to the English. Expeditions sent out by Canadian surveys are constantly opening up new countries and producing maps of great geographical and industrial value. Mr. A. P. Low finds Labrador not quite so bleak and hopeless a country as had been generally believed. Sir Martin Conway has done some very creditable exploration in the Andes and in Tierra del Fuego, the scientific results of which are of considerable value. In Chile, Dr. Staffer and his colleagues have been exploring the wonderful fiords of the coast and the rivers that come down to them from the Andean range. Dr. Moreno has described the results of twenty-five years' exploration of the great Patagonian plains, and of the lakes and glaciers and mountains on the eastern face of the Andes. One of the most important scientific enterprises during the year, the London Times says, was the German oceanographical expedition in the Valdivia, under Professor Chum, which went south through the Atlantic to the edge of the antarctic ice, and north through the Indian Ocean to Sumatra, and home through the Red Sea.

Royal Society Medalists.—The Copley medal was conferred, at the recent anniversary meeting of the Royal Society, upon Lord Rayleigh for his splendid service to physics, his investigations, the

president said in presenting the award, having increased our knowledge in almost every department of physical science, covering the experimental as well as the mathematical parts of the subject. "His researches, from the range of subjects they cover, their abundance, and their importance, have rarely been paralleled in the history of physical science." A summary account of the principal ones was given in the sketch of him published in the twenty-fifth volume of the Popular Science Monthly (October, 1884). At the same meeting of the Royal Society the Royal medals were conferred upon Prof. G. F. Fitzgerald, for his brilliant contributions to physics, and Prof. William C. McIntosh, for his very important labors as a zoölogist. Professor Fitzgerald's investigations have been in the field of radiation and electrical theory, and in a manner complementary to those of J. Clerke Maxwell. Among his works is a memoir presenting a dynamic formulation of the electric theory of light on the basis of the principle of least action, which concludes with a remark upon the advantage of "emancipating our minds from the thraldom of a material ether." Professor McIntosh was spoken of as "one of a distinguished succession of monographers of the British fauna, who, beginning with Edward Forbes, have, during the last fifty years, done work highly creditable to British zoölogy." He is author of a great monograph of the British Annelids, which is still in progress of publication by the Royal Society, and of an important contribution to the Challenger reports, and was the founder of the first marine biological station in Great Britain—the Gatty Marine Laboratory at St. Andrews. The Davy medal was bestowed upon Edward Schunck for researches of very high importance in organic chemistry. These works include a remarkable series of contributions to the chemistry of the organic coloring matters, particularly those relating to the indigo plant and to the madder plant. Of late years he has studied, with distinguished success, the chemistry of chlorophyll.

Anglo-Saxon Superiority.—The question of the superiority of the Anglo-Saxon race is at present interesting economists of other stocks, especially of the supposed Latin races. The fact of superiority seems to be conceded. The problem is to account for it. A French writer, M. Dumoulins, attributes it to the superiority of Anglo-Saxon educational institutions. Signor G. Sergi, the distinguished Italian anthropologist, thinks it is a result of the mixture of ethnic elements of which the English people are made up, and he goes over the history of the colonizations which have overtaken Britain, to show how upon the first neolithic settlers of the Mediterranean stocks came a small emigration of the Asiatic Aryan or Indo-European peoples. Cæsar's conquest brought in a Roman infusion with some African elements, which did not last long, but left their mark. Next the Anglo-Saxon tribes of northern Germany made the principal contribution to the formation of the English people. A portion of Scandinavian blood was added to the composition, and on top of all came the Normans. These elements, none of which were extremely discordant with the others, became thoroughly mixed in the course of time, and matured into the English people as it is. The English resemble the Romans in their methods of colonization, political tact, practical sense, persistence, religious tolerance, the magnitude of their works and the boldness of their undertakings, and in their egotism working together with the principle of social solidarity. Both readily established themselves in new colonies, carrying there the civilization of the mother country and their systems of administration. The great roads and wonderful bridges constructed by the Romans are paralleled by the great Anglo-Saxon railway systems. As the Latin language became almost universal, so the English language is diffusing itself everywhere. But Signor Sergi fails to show why, if the English have taken so much from the Romans, the Italians, their direct descendants, have lost so much of what they once had. He reserves that question, after raising it, for future consideration.

[621]

Carbonic Acid and Climate.—The great importance of the carbonic acid in the atmosphere as a factor in determining the climate of the earth has been confirmed by the researches of a considerable number of investigators. Its work appears to be that of an absorbent of the sun's radiant heat, retaining it and preventing its passing by us and leaving us in the cold temperature of space.

Tyndall computes that it has in this capacity a power eighty times that of oxygen or nitrogen, while it is excelled by water vapor with ninety-two times that of those gases. Lecher and Pretner, on the other hand, believe that carbonic acid is the only agent concerned in the service. Mr. Cyrus F. Talman, Jr., in view of the fact that carbonic acid is an important factor among geological agencies, has published, in the Journal of Geology, a study of the conditions of the content of that gas in the ocean, a study that leads to the consideration of the chemistry of the ocean. It seems to be clear that with falling temperature the ocean will dissolve carbonic acid from the air. Dr. T. C. Chamberlin has shown that the amount of carbonic acid in the atmosphere at any one time, and therefore the climate of the earth at that time, depends upon the value of the ratio of the supply of the gas to its depletion. Besides the continuous supply that the atmosphere receives from the interior of the earth and from planetary space and the continuous depletion due to the formation of carbonates in place of the igneous alkali earth silicates, there are variations in the ratio of supply to depletion dependent upon the attitude of the land and the water. A large exposure of land surface is correlated with a rapid solution of calcium and magnesium carbonates, which, becoming bicarbonates, represent a loss of carbonic acid to the atmosphere. On the other hand, the formation of the normal carbonate by lime-secreting animals causes a direct liberation of the second equivalent of the bicarbonate. Therefore extensive oceans and abundant marine life are correlated with warm climate. After a somewhat more minute discussion of the action, Mr. Talman concludes that the ocean very greatly intensifies the secular variation of the earth's temperature, although acting as a moderating agent in the minor cycles.

Pearl Mussels.—In his report to the United States Fish Commission on the Pearly Fresh-Water Mussels of the United States, Mr. Charles T. Simpson speaks of the great variety of conditions under which they live. They show great capacity for adaptation. Most of them are found in shallow water, but certain forms live at considerable depths. Some bury themselves among the fibrous roots of trees, some in the muddy, sandy banks just below the surface of the water, and some, as in Lake Tiberias (Palestine) and Lake Tanganyika (Africa), under six hundred or more feet of water. Ordinarily they die in a very short time if taken out of the water—in from twenty-four to forty-eight hours, as a rule—and they generally die in a few hours when exposed to the sun. But many species, thus tender in the open air, will lie buried in dried mud for a long time. In June, 1850, a living pond mussel was sent to London, from Australia, which had been out of water for more than a year. Along a small stream near Braidentown, Fla., which runs only during about three months in summer and is dry the rest of the year, thousands of a large colony of *Unio obesus* may be found just buried in the sandy banks or among the flags and rushes of the bottom, where there is very little moisture, all in healthy condition. Mr. Simpson has laid these mussels in the sun for months without killing them. The specimens which live in perennial water seem to die soon if removed from it, while those which inhabit streams or ponds that often dry up will live a long time out of water. Some species in rocky streams live in the crevices of the rocks. In the Big Vermilion River, in La Salle County, Illinois, a swift, rocky stream, the author has found living mussels that had been so washed about that nearly all the epidermis was destroyed. The shells in such streams are usually heavier than those in more quiet water.

MINOR PARAGRAPHS.

Prof. Frederick Starr, of the University of Chicago, has made two excursions to Mexico for the purpose of establishing the physical types of the aborigines by means of measurements, photographs, and casts. He studied twelve tribes, half of which were almost unknown to science, and made measurements of more than eleven hundred and fifty men and three hundred women. On his last trip he rode one thousand miles among the mountains on horseback. In a recent paper in the Open Court he takes notice of frequent and curious survivals of pagan belief to be remarked among these peoples, although they are all supposed to be devout Christians. In one instance, which is specially described, an idol bearing some resemblance to those found among the ruins of the ancient cities occupied a station in the church by the side of the crucifix, sharing the honors with the statue of the Virgin on the other side. Grief and consternation prevailed among the Indians when the idol was taken away by the ecclesiastical authorities.

The question of the increase of insanity in England during the last few years is regarded as assuming a serious aspect, and the report of the Commissioners of Lunacy for 1898, showing the largest annual increase yet recorded, the Lancet says, reveals the gravity of the situation. Other collateral facts given in the report "add to the seriousness of the outlook." The increase in the number of inmates in institutions for lunatics is attended with a falling off in the recovery rate, which is lower for 1898 than that of the previous year, and even than the average of the last ten years. A steady diminution in the recovery rate has appeared also during each period of five years since 1873. The attempt to account for the increase of lunatics in public and private asylums by supposing that it is made up by removals thither from workhouses or from the care of relatives fails, for it is shown that this class of insane is increasing too, though slowly. The subject is regarded as of so much importance that it was considered and discussed in the Psychological Section of the British Association at its Bristol meeting in 1899.

A process by which calcium carbide can be continuously produced more cheaply than by the process at present in use is reported, in Industries and Iron, to have been discovered by Professor Freeman, of Chicago. In the new process a huge arc lamp inclosed in brickwork in the interior of a furnace is employed. The upper electrode of the lamp is hollow, and through it is fed a powder composed of common lime and coke. This powder, being carried through the upper carbon directly into the electric flame, is melted by the intense heat, and molten calcium carbide runs away from the furnace. It is estimated that the carbide is produced at a cost of half a cent per pound.

NOTES.

A new method of securing more perfect combustion, described by Mr. Paul J. Schlicht before the Franklin Institute, is based on the fact, described by the inventor, that if a current of air is properly introduced into a chimney flue through which hot products of combustion are escaping, it will flow in a direction contrary to theirs, and, becoming heated in contact with them, will reach the center of the fire in a condition highly favorable to the most complete union of oxygen with the combustible elements of the fuel. Suggestions are made in Mr. Schlicht's paper for the construction and regulation of furnaces, so as to secure the condition described.

Mr. Edward Orton, Jr., has been appointed State Geologist of Ohio, to succeed his father, the late Dr. Edward Orton. He has been connected, as an assistant, with the survey, in which he studied the distribution of the coal measures, and has also prepared reports on the clay and clay industries of the State.

"From a moral if not from a scientific and industrial point of view, incontestably superior to that of the European peoples," is the characterization a book reviewer in the *Revue Scientifique* gives to Chinese civilization.

Sir William Turner is the president-elect for the Bradford meeting of the British Association, 1900. He is head of the great medical school at Edinburgh, and President of the General Medical Council, and was pronounced by Lord Lister, in nominating him, the foremost human anatomist in the British Islands, and also a great anthropologist.

A gold medal is offered by the Society of Agricultural Industry and Commerce of Milan to the inventor of the best apparatus or the person who will make known the best method for protecting working electricians against the accidents of their profession. The competition is open to all nations.

The statue of Lavoisier, called by the French "the founder of chemistry," is to be erected, during the Universal Exposition in Paris, on the square of the Madeleine, at the intersection of the Rue Tronchet. The work is in charge of the sculptor Barrias. The sum of ninety-eight thousand francs, or nineteen thousand six hundred dollars, has been subscribed to pay for it.

The death list of the last few weeks of men known in science includes a considerable proportion of important names. Among the number are John B. Stallo, formerly of Cincinnati, author of General Principles of the Philosophy of Nature, The Concepts and Theories of Modern Science, and numerous contributions to scientific publications, recently United States minister to Italy, in Florence, December 30th, in his seventy-fifth year; Sir James Paget, for many years the leading surgeon in England, and author of books relating to surgery, in London, December 30th, in his eighty-sixth year; Dr. Thomas C. Egleston, Emeritus Professor of Mineralogy and Metallurgy in Columbia University, in New York, January 15th; Prof. Henry Allen Hazen, one of the chief forecasters of the United States Weather Bureau, and author of improvements in the methods employed there, in Washington, from the results of a bicycle collision, January 22d, in his fifty-first year; Dr. Wilhelm Zenker, a distinguished physicist, at Berlin, October 21st, aged seventy years; Augustus Doerflinger, an engineer who was engaged in the work of the removal of Hell Gate in New York Harbor, at Brooklyn, November 24th, in his fifty-eighth year; Johann Carl Wilhelm Ferdinand Tiemann, Professor of Chemistry in the University of Berlin and late editor of the Reports of the German Chemical Society, at Meran, Tyrol, November 17th, in his fifty-second year; he was distinguished for his researches upon the constitution of odoriferous principles, including works on vanillin, the aroma of the violet, terpenes, and camphor, and the synthesis of amido-acids; Dr. Birch-Hirschfeld, Professor of Pathology in the University of Berlin, aged fifty-seven years; Sir Richard Thorne Thorne, principal medical officer to the Local Government Board, in London, December 18th, aged fifty-eight years; author of many official reports relating to the public health, of works on the progress of preventive medicine during the Victorian era, and of lectures on diphtheria and the administrative control of tuberculosis; Dr. John Frederick Hodges, Professor of Agriculture and lecturer on medical jurisprudence in Queen's College, Belfast, Ireland, and author of two elementary books on chemistry, The Structure and Physiology of the Animals of the Farm, and of several papers published in the Proceedings of Scientific Societies; E. C. C. Stanford, a practical chemist, distinguished for the introduction of several original methods of manufacture, and for the preparation of several new substances, such as algin and thyroglandin; he was the author of the monograph on the iodine industry in Thorpe's Dictionary of Chemistry; and John Ruskin, who, though not a man of science in the strict sense of the term, did his full share for the advancement of knowledge and comfort among men, at Coniston Lake, England, January 20th, in his eighty-first year.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Bulletins and Reports. Summary of Feeding-Stuffs Law in Force in New York after December 1, 1899. P. 1. Bulletin No. 159. A Pest of Woodland and Grove. (The Forest Tent Caterpillar). By F. H. Hall and V. H. Lowe. Pp. 5; No. 160. Report of Analyses of Commercial Fertilizers for the Fall of 1899. By L. S. Van Slyke. Pp. 102; No. 161. Popular Edition. Gooseberry Mildew held in Check. By F. H. Hall and C. P. Close. Pp. 4; Newspaper Summaries of these Three Bulletins. P. 1.

Carter, Oscar C. S. Coastal Topography of the United States. Pp. 30.

Connecticut, State of. Fifteenth Annual Report of the Bureau of Labor Statistics for the Year ending September 30, 1899. Pp. 266.

Densmore, Emmet, M. D. Consumption and Kindred Diseases. (Open-air Treatment.) Brooklyn, N. Y.: The Stillmann Publishing Company. Pp. 138.

Douglas, James, New York City. American Transcontinental Lines. Pp. 56.

Fry, the Right Hon. Sir Edward, and Agnes. The Mycetozoa and some Questions which they Suggest. London: "Knowledge" Office. Pp. 82. 1 shilling.

Gay, Albert, and Yeaman, C. H. An Introduction to the Study of Central Station Electricity Supply. New York: The Macmillan Company. Pp. 167. $3.

Johnston, Charles. The Memory of Past Births. New York: The Metaphysical Publishing Company. Pp. 50. 25 cents.

King, F. H. Irrigation and Drainage. Principles and Practice of their Cultural Phases. New York: The Macmillan Company. Pp. 502. $1.50.

Kunz, George F. The Production of Precious Stones in 1898. United States Geological Survey. Pp. 48, with plate.

Marine Biological Laboratory, at Woods Holl, Mass. Announcement for the Thirteenth Season. July 5 to August 16, 1900. Pp. 12.

McKay, A. H., Halifax, Nova Scotia. Phenological Observations, Canada, 1898. Pp. 20.

McKim, W. Duncan. Heredity and Human Progress. New York: G. P. Putnam's Sons. Pp. 283. $1.50.

Michigan. Thirty-seventh Annual Report of the Secretary of the State Board of Agriculture, and Eleventh Annual Report of the Agricultural College Experiment Station. July 1, 1897, to June 30, 1898. Pp. 740.

New York State Library Bulletin. (Legislation No. 11, January, 1900.) Albany. Pp. 395. 25 cents.

Parker, T. Jaffrey, and Haswell, William A. A Manual of Zoölogy. Revised and adapted for the use of American Schools and Colleges. New York: The Macmillan Company. Pp. 163. $1.60.

Peet, Stephen Denison. The Cliff-Dwellers and the Pueblos. Chicago: Office of the American Antiquarian. Pp. 398.

Smithsonian Institution. List of Publications available for Distribution. December, 1899. Pp. 35.

Sound Currency. October, 1899. Deposit Currency; the Effective Currency of Commercial Communities. Pp. 12. November, 1899. The Farmer's Interest in the Banking Question. Pp. 8. Both by L. Carroll Root.

Spencer, Frank Clarence. Education of the Pueblo Child. A Study

in Arrested Development. (Columbia University Contributions to Philosophy, Psychology, and Education. Vol. VII, No. 1.) New York: The Macmillan Company. Pp. 97. 75 cents.

United States Commissioner of Education. Report for the Year 1897-'98. Vol. II. Containing Parts II and III. Pp. 2640.

United States Commissioner of Fish and Fisheries. The Preservation of Fishery Products for Food. By Charles H. Stevenson. Pp. 570.

United States Department of Labor. Bulletin No. 25. November, 1899. Foreign Labor Laws. Pp. 80.

FOOTNOTES:

[1] Lyell's Principles of Geology, eighth edition, p. 41.

[2] Clarence King, American Journal of Science, pp. 45-51, 1893; Kelvin, Science, vol. ix, p. 665, 1899.

[3] Science, vol. ix, p. 665, 1899.

[4] Ibid., p. 889, and vols. x and xi, 1899.

[5] Life and Letters of Sir Joseph Prestwich, pp. 124 *et seq.*

[6] Critical Periods, etc., American Journal of Science, vol. xiv, p. 99, 1877; Bulletin of the Geological Department of the University of California, vol. i, No. 11, 1895.

[7] Journal of Geology, vol. vi, p. 597, 1898, and vol. vii, p. 545, 1899.

[8] Views similar to those of Professor Bautz have been advocated by a French Jesuit, Père F. H. Schouppe, in a work entitled The Doctrine of Purgatory elucidated by Facts and Private Revelations. The "facts" consist of the visions of saints, and the "private revelations" prove to be apparitions of souls in purgatory to hysterical women and other persons "blasted with ecstasy." The book has been translated into German by a Tyrolese priest, G. Pletl, and just published at Brixen, "with the approbation of the Prince Bishop." An Austrian journal, the Ostdeutsche Rundschau, printed extracts from the volume with appropriate comments, and was confiscated by the Government in Vienna for "offense to religion."

[9] The manner in which The Pelican makes piety profitable is most extraordinary and should win the admiration and excite the envy of the "yellow press." The editor informs the public that he entered into a compact with St. Joseph, promising to distribute fifty books in which this holy person is glorified, provided the journal receives two thousand subscribers. In less than a year the number of subscribers was twenty-five hundred. A promise to distribute one hundred books of this kind, if St. Joseph would procure eight thousand subscribers, raised the list of subscribers to twelve thousand; and this barter went on until The Pelican could boast of ninety thousand subscribers. The editor also announces that he has engaged two hundred and eighty priests to say masses for the readers of his paper and to pray for and bless their children, and concludes this astounding piece of puffery as follows: "Experience teaches us that the benediction of a single priest is effective. What, then, can not be obtained if two hundred and eighty priests unite in blessing us!"

[10] *Cf.* Popular Science Monthly, November, 1895, p. 83.

[11] Studies from the Yale Psychological Laboratory, vol. vi.

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