to point out some disadvantages of the alternating system. The advantages of the system, as allowing the distribution of incandescent lights over extended areas, are so well known, that it is no more than fair that the drawbacks should be recognized, as it is by the honest investigation of every side of a case that science and industries advance. It was pointed out in the paper on motors referred to above, that the energy, being transformed, which is equal to CE, the product of the electro-motive force by the current, could be changed in two ways: supposing E is constant, we can either change the absolute value of C, or we change the position of its maximum with respect to the maximum of E. Now, if the former was what actually occurred, as we decreased the work being done, — turned out a number of lamps, for instance, — we would decrease the current; and the heating of the line wire, equal approximately to $\frac{C_0^2}{2} R$, would decrease in a still greater proportion. But this is not what really occurs. We have only a partial decrease of current, the total decrease being partly made up by a shift of the position of the curve representing C. It was pointed out that this was a disadvantage, as the heating of the line was independent of the *position* of the current curve, depending simply on its *value*. There is another disadvantage in this, which was not mentioned in the paper referred to. A dynamo cannot carry more than a certain current, corresponding to its maximum capacity. Now, if there were absolutely no change in the *value* of the current from full load to no load, it would mean that all of the dynamos in the station would have to be run all the time; for, if we distributed the current among a few of them, they would rapidly heat and burn out. It is evident that this state of affairs would be most uneconomical, since the absolute number of horse-power lost in each machine varies very little with the load, and, besides these losses, we have the depreciation and wear on the machinery. Of course, the engines, supposing there were no lamps being burned, would be doing very little work, running uneconomically. In practice we do not have this state of affairs: the current *does* decrease in value as lamps are turned out in the secondary circuits, but it *does not* decrease proportionally to the lamps turned out, and we must run more dynamos than are necessary to supply the energy required in the lamps; and this at a reduced load, and therefore at a low efficiency. There are a number of interesting points that might be brought out here, but until I have calculated the results of some experiments, and have from them some reliable data as to the magnitude of the different effects, I will not push the matter further.

From Mr. Smith's paper it would seem that the Westinghouse Company have found it best to run the converters separately; that is, not to join a number of them in parallel. Now, the objections to this are, 1st, that it does not allow the converting system to take advantage of the law of averages; and, 2d, that as each converter is only working for a limited time on full load, and as the efficiency on partial loads is not great, the total efficiency is much reduced. As for the first, it is well known that if the total number of lamps in a certain district is, say, 2,000, the maximum capacity of the station required to supply them by a direct system will be very much less, say, 1,000 lamps; this, of course, because all the houses in the district will never have all of their lamps burning at once. If, however, we wish to supply them by converters, using a converter in each house, the capacity of our converters would have to be 2,000 lamps, since any one house might have all the lamps burning on some special occasion. If we calculate the amount of gas we could burn in a month, supposing each jet were burning all the time, and compare with the amount we actually do burn, we will find that we use, perhaps, one-twentieth part of the maximum capacity of our lights. Now, a converter working at an average of one-twentieth of its capacity is not an especially economical machine.

The above considerations must interfere with the economy of the alternating system; still it must be remembered that the system is already successful in so many cases, that, in spite of these drawbacks, the field before it is immense. In Mr. Smith's paper it is especially gratifying to notice how the system has been improved, and is still being improved.

Mr. W. L. Church read a paper on 'Independent Engines for Incandescent Electric-Light Stations,' in which he pointed out, that, when the amount of energy required from an electric-lighting station varies within wide limits, it is better to have a number of small engines to drive the dynamos than one large engine. The reason evidently is, that while a large slow-speed engine is more economical than high-speed engines of smaller size, when both are working at a maximum efficiency, yet our single large engine would only be working at full load for a small part of the day, while the rest of the time it would be doing only a small part of its possible work, and its efficiency would be low. With a number of small engines, on the other hand, when our load decreases, we can shut off some of the engines and dynamos, keeping those that are left up to very nearly their maximum efficiency. Another point in favor of the small engines is, that they may be belted directly to the dynamos, thus avoiding the loss in the countershafting used with the large machine, — a loss that might amount to twenty per cent.

Among the other papers read was a very valuable one on electric motors by Dr. G. A. Liebig; while there were a number of others, all of considerable technical interest.

Pres. J. F. Morrison having declined a re-election, Mr. S. A. Duncan of Pittsburgh was unanimously elected president of the association.

Taken altogether, the meeting was the most important, both as regards attendance and the papers read, that the association has yet held.

WASHINGTON SCIENTIFIC NEWS.

Maj. J. W. Powell on Evolution in Civilized Man. — Ascertaining the Density of the Earth. — Submarine Oil-Springs in the Pacific.

Evolution in Civilized Man.

THE annual meeting of the Anthropological Society was held on Tuesday evening, March 6. Maj. J. W. Powell, the retiring president of the society, occupied the evening by reading a paper, the sixth of a series on the same subject, on the evolution of man.

In the opening portions of his address, Major Powell explained the doctrine of evolution as taught in the philosophy of Darwin and embodied in the phrases 'the survival of the fittest in the struggle for existence' and 'natural selection.' "Nature," he said, "gives more lives than she can support: there are more individuals requiring nourishment than there is food. Only those live that obtain sufficient nutriment, and only those live that find a habitat. Of the multitude of germs, some perish on the rocks, some languish in the darkness, some are drowned in the waters, and some are devoured by other living beings. A few live because they fall not upon the rocks, but are implanted in the soils; because they are not buried in the darkness, but are bathed in the sunlight; because they are not overwhelmed by deep waters, but are nourished by gentle rains; or because they are not devoured by the hungry, but dwell among the living. A few live because they are the favorites of surrounding circumstances. In the more stately phrase of the philosophy of evolution, they are 'adapted to the environment.' Evolution, or progress in life, is accomplished among animals or plants by killing the weaker, — the less favored, — and by saving the stronger and more favored. Many must be killed because there are too many, and so the best only are preserved. Those a little above the average are saved, and this is called 'natural selection.' But this general statement must be followed a little further, that its deeper significance may be grasped."

Major Powell then illustrated the operation of the law of evolution by showing the infinite variety of conditions presented by the earth as the home of living beings, some of the ways in which competition for life is carried on, and the manner in which plants become more perfect, and animals advanced. "The endeavor has been made," he said, "to show what the struggle for existence means, and the part which competition plays in biotic evolution. Competition among plants and animals is fierce, merciless, and deadly; out of competition fear and pain are born; out of competition come anger and hatred and ferocity. But it must not be forgotten that from this same competition there arise things more beautiful and lovely, — the wing of a butterfly, the plumage of the bird, and the fur of the beast; the hum of the honey-bee, the song of the nightingale, and the chatter of the squirrel. So good and evil dwell together."

Having thus characterized that competition which obtains among the plants and lower animals in the struggle for life, Major Powell continued, "It is proposed to characterize the competition which exists in the higher civilization between man and man, and to show in what respect it may be like, and in what respect it may be different from, biotic, which exists in the lower orders of creation; and for this purpose the savage and barbaric tribes of men will be neglected. Nor will the nations of early civilization be considered, but only mankind as he has obtained the highest civilization at the present time.

"In civilization, man does not compete with plants for existence. Thorns cannot drive him from fruits, husks cannot hide nutritious seeds from his eye, shells cannot defend sweet nuts from his grasp; but he speedily destroys from the face of the earth the plants which are not of the highest value for his purpose, and he plants those that are of value, and multiplies them in a marvellous manner, and by skilled culture he steadily improves their character, making the sweet sweeter, the rich richer, and the abundant more abundant.

"In the higher civilization, man does not compete with the beast for existence. There are no howling wolves or bears on our farms, there are no lions or tigers in civilized lands, and there are no serpents in our cities. All these dwell where civilization has not yet conquered its way. Civilized man has domesticated the animal: he hives the bee for its honey, he coops the bird for its eggs, he pastures the cow for her milk, and he stables the horse that his boy may ride on its back.

"In the highest civilization, the world is not crowded with human beings beyond their ability to procure sustentation; for, if some hunger, it is not because of the lack of the world's food, but because of the imperfect distribution of that food to all. Men are not crowded against plants, men are not crowded against beasts, and men are not crowded against one another. The land is yet broad enough for all. The valleys are not all filled, the hillsides are not all covered. The portion of the earth that is actually cultivated and utilized to supply the wants of man is very small: it compares with all the land as a garden to a plain, an orchard to a forest, a meadow to a prairie. Nature is prodigal of her gifts. The sweet air, as it sweeps from zone to zone, is more than enough to fan every cheek; the pure water that falls from the heavens and refreshes the earth, and is again carried to the heavens on chariots of light, is more than enough to refresh all mankind; the bounteous earth, spread out in great continents, is more than enough to furnish every man a home; and the illimitable sea has wealth for man that yet has not been touched. Thus it is that in human evolution over-population is not a factor, as it is in biotic evolution.

"In the highest civilization, man does not compete with man in the struggle for existence, and thus human competition is not biotic competition. In biotic evolution the wolf devours the fawn; but on the average he devours the weakest fawn, and the strongest fawn lives to beget a fleeter race of stags; and the evolution of stag-life is accomplished by such means. But when the highwayman waylays the traveller, and there is a struggle for existence which ends in a murder, no step in human evolution is accomplished thereby.

"Again: in the higher civilization, man does not compete with man in the direct struggle for the means of existence as does the brute. In the struggle for subsistence, one ox gores another to drive him from a blade of grass, one wolf rends another to drive him from a bone. Among the animals the struggle for the means of existence is direct, rapacious, and cruel; but in civilized society man shares with his fellow-man: the poor and the unfortunate are fed at the table of charity. A maimed beast is driven from the crib, but men and women will vie with one another to serve a maimed man; and one of the highest aspirations of civilized society is to dispense generous hospitality.

"Vestiges of brutal competition still exist in the highest civilization, but they are called crimes; and, to prevent this struggle for existence, penal codes are enacted, prisons are built, and gallowses are erected. Competition in the struggle for existence is the agency by which progress is secured in plant and animal life, but competition in the struggle for existence among men is *crime* most degrading. Brute struggles with brute for life, and in the æons of time this struggle has wrought that marvellous transformation which we call the evolution of animals; but man struggles with man for existence, and murder runs riot: no step in human progress is made.

"That struggle for existence between man and man which we have considered and called crime is a struggle of one individual with another. But there is an organized struggle of bodies of men with bodies of men, which is not characterized as murder, but is designated as warfare. Here, then, we have man struggling with man on a large scale, and here it is where some of our modern writers on evolution discover the natural law of selection, — 'the survival of the fittest in the struggle for existence.' The strongest army survives in the grand average of the wars of the world.

"When armies are organized in modern civilization, the very strongest and best are selected, and the soldiers of the world are gathered from their homes in the prime of manhood and in lusty health. If there is one deformed, if there is one maimed, if there is one weaker of intellect, he is left at home to continue the stock, while the strong and the courageous are selected to be destroyed. In organized warfare the processes of natural selection are reversed: the fittest to live are killed, the fittest to die are preserved; and in the grand average the weak, physically, mentally, and morally, are selected to become the propagators of the race."

After illustrating this point at some length, Major Powell said that it must now be shown what man has done with this law of evolution.

"A river has a precipice in its course, and where the water falls there is danger to man. The Indian, drifting in his canoe too near to the brink, is carried over the cataract, and his bones are left to bleach upon the rocks below. But at the same place the civilized man finds a power, and about the cataract he builds a city, and with the cataract he runs his mills and factories, and that which was a power of destruction to the savage is a beneficent agent in civilization.

"Two summers ago a young friend of mine, with two comrades, was sailing a boat on Yellowstone Lake. As he neared the shore, a little cloud spread overhead; then something happened that the members of the party knew not, for it came as an instant flash. Some time after the flash of unconsciousness, my friend, who was the leader of the party and the captain of the boat, opened his eyes once more to the light of day, and the sail of his little boat was all ablaze, and the mast was on fire, and a hole had been pierced in the bottom of his boat, and the waters of the lake were boiling up to fill it, and the gunwales of the boat were sinking down to the water's edge, and before him in the boat were two prostrate forms, — one paralyzed by the lightning-stroke, and the other dead from the lightning-stroke, — and he himself had his right arm seared by the terrible bolt; and the boat sank, but in shallow water; and the living struggled out to land, and the maimed buried the dead on the shores of the lake in the land of the beautiful. How terrible is the lightning-stroke! I had another friend whose daughter was stricken with dire disease, and the wife and mother started with the invalid daughter to go beyond the seas, hoping that the mild breezes of the Mediterranean might waft the balm of healing to the loved one while she dwelt on Italian shores; but as the loved ones sailed away, and were lost behind the curve of the world, a great fear came over the heart of my friend that his loved daughter would not live to reach the farther land. Day by day the fear grew; but one day a flash of lightning came from beyond the sea through the ocean depths, and brought him a message of their safety. So the genius of man has transformed the very lightning of destruction into a messenger of love and joy.

"It is in the same manner that the genius of man has transformed this brutal, this cruel law of evolution into a beneficent agency for his own improvement; and to explain this is our delightful task.

"From the dawn of human culture in savagery, to the mid-day of culture in civilization, human genius has been producing many inventions for many purposes, and the good have given place to the better, and the better have yielded to the best.

"A sheep gathers the grass with his teeth, the ox with his tongue, and the horse with his lips; and teeth, tongues, and lips are modified and developed as these animals struggle for existence. But the savage, just a little higher than the brute, walks through natural meadows, and, with a stick in one hand, beats the grain from

the stalks of grass into a basket held in the other; then, to separate the grain from the chaff, he tosses it on a tray, that the passing breeze may cleanse it; then the grain is roasted, and ground between stones, one lying on the ground, and another held in the hands, — two mealing-stones; and the flour is spread on a stone, and baked into a cake on the coals. So stick and basket and tray and mealing-stones and baking-stone are the implements and devices for gathering and preparing the cereal food of the savage. Then man invents a reaping-hook, then a grain-cradle, then a reaper; and in the process of invention from the sickle to the reaper, what a multitude of inventions are developed! Along this course how many tools, implements, and machines become obsolete and useless, that the one great reaper may remain! Here it is that we have 'the survival of the fittest in the struggle for existence;' and man, by his genius, transfers this struggle from himself to the work of his hands. The way from basket-reaping to power-reaping is long, but all the steps that way have been taken in the endeavor of mankind to secure greater happiness."

Major Powell also illustrated the evolution of the power-thresher from the flail, of the most improved winnowing-machine from the fanning-tray, of the steam or water power flouring-mill from the mealing-stones, etc.

"The sheep, the ox, and the horse make their struggle for existence with teeth, tongue, and lips; but mankind has passed beyond the stage where he must struggle for existence, into that condition where he endeavors to secure greater happiness. Tongue, teeth, and lips are no longer developed along the line of animal evolution; but human evolution is established by the development of human arts, and this struggle for existence is transferred to painless objects."

This truth was further illustrated by describing the evolution of the chronometer from the clepsydra and the hour-glass, and of the ocean steamship from the raft.

"Among bi-sexual animals, one of the agencies of evolution is sexual selection. Brutes fight with one another for mates, and in the grand aggregate the weaker are killed, and the stronger are preserved to perpetuate their kind; and various devices are gradually developed for attracting and winning mates, and the forms, colors, and habits of animals are modified thereby. But even in savagery this battle for sexual love is largely avoided, and, that peace may be preserved, marriage institutions are established. It seems at first that men in groups agree to marry women in groups. A group of men holding a group of women in common, defend one another's rights from violation from without, and live together in peace. On this plan there supervenes another system of institutions for marriage, where a group of men are destined to become husbands of a group of women in severalty, and the selections are not made by the parties themselves, but by the elders; that is, where marriage is by legal appointment within prescribed groups. Thus marriage institutions change from age to age, and from state of culture to state of culture, until the highest civilization is reached, where the man marries the woman of his choice on the sole condition that he is the man of her choice, and where the man must have but one wife, and the woman but one husband, and the twain are one in love, in purpose, and in law. But in the course of this evolution of marriage institutions, how many customs have obtained, how many agreements have been made, how many laws have been enacted! And along the entire course of the history of marriage institutions, customs and laws have disappeared, that new and better customs and laws might take their places; and the struggle for mates existing among the lower animals has been replaced by the endeavor to secure peace and happiness in human society. Thus man has transferred the struggle for existence from himself to his institutions. The marriage ceremony of the beast with his mate is a battle with a rival: the marriage of a man with his mate is a festival of kindreds and friends. And wherever any vestige of the beastly struggle remains in human society, there crime is committed, and the course of human evolution is checked. The way from communal marriage to monogamy and personal choice is very long, but every step in it has been taken by man in his endeavor to secure greater happiness."

The evolution of institutions was further shown by the establishment of authority, the history of which was traced from the elder-right through the right of the noble, by constant and long endeavor, into the right of the representative.

"Comparing animals with men, among the brutes rights and duties are distributed by hoofs and claws and horns and fangs, and by all brutal powers; but among men rights and duties are distributed by institutions.

"In this brief review of the growth of institutions, it is observed that forms of government are ever changing, that the constitution of the State is ever changing, and that the laws are ever changing. As these changes proceed, better institutions are selected by men; and thus is secured a 'survival of the fittest in the struggle for existence' among institutions. In civilization man does not struggle with man for existence; but by the invention of institutions he emancipates himself from the reign of terror inherent in brutal competition, and transfers the struggle from himself to the institutions of his creation.

"All of this statement may be summarized in this manner: man does not compete with plants and animals for existence, for he emancipates himself from that struggle by the invention of arts; and, again, man does not compete with his fellow-man for existence, for he emancipates himself from that brutal struggle by the invention of institutions. Animal evolution arises out of the struggle for existence; human evolution arises out of the endeavor to secure happiness: it is a conscious effort for improvement in condition.

"But arts and institutions alone have not secured the evolution of mankind, for they have been powerfully aided by two other classes of human invention, — namely, linguistics and opinions, — and the part which they have taken must be mentioned."

Major Powell then showed that the same struggle for existence, and the same survival of the fittest by human selection, which have been found among inventions, and again among institutions, may be discovered among languages and linguistic methods and devices. "By human endeavor, man has created speech, by which he may express his thoughts. And out of this endeavor, in all lands and in all time, the unorganized languages of savages have been developed into the languages of modern civilization; and all this progress, all this evolution, is by human endeavor; and in it natural selection, as that term is understood in biology, has played no part.

"Along the course of human progress opinions have been changing. The cruelty of nature in biotic evolution has been set forth. In this figure of speech, Nature is personified, and, if we still personify Nature, to the savage man Nature was ever a deceiver and a cheat.

"Nature tells the savage that the earth is flat, over which the sky is arched as a solid dome; then Nature tells the savage that the sun travels over the flat earth, and under the sky of ice, by day from east to west, and returns again in a cave by night from west to east; then Nature tells the savage that the rain comes from the melting of the ice of the sky. Many, strange, foolish, and false are the stories that Nature tells to the untutored savage. Nature is the Gulliver of Gullivers, the Munchausen of Munchausens. Nature teaches men to believe in wizards and in ghosts. Nature fills the human mind with foolish superstitions and horrible beliefs. The opinions of the natural man fill him with many fears, give him many pains, and cause him to commit many crimes. Out of all these savage superstitions, man has travelled a long way into the light of science. And how shall the opinions of modern civilization be characterized? And who can tell how the knowledge of the highest civilization transcends the knowledge of the lowest savagery? And so opinions have been changing, — old opinions have died, and new opinions have been born, — and philosophies have struggled for existence as man has endeavored to learn; and with man forever the struggle to know has been the endeavor to secure happiness, for truth is good, and wisdom is joy.

"Attention has already been called to the fact that among the lowest forms of life there exists a marvellous rate of reproduction. As life advances, and plants and animals are developed, the powers of reproduction are curtailed, until man in the highest civilization, and in the highest culture of that civilization, is reached, when the rate of reproduction is at a minimum. In this state of culture the transfer of the struggle for existence from man to the works of his creation is completed. With this transfer there occurs another of

wonderful nature. The marvellous powers of reproduction are transferred from the body of man to the soul of man, and he multiplies his intellectual creations at an amazing rate. Arts are multiplied to secure the joys of life, institutions are multiplied to secure justice, linguistics are multiplied to secure mental communication, and multiplied truths are discovered, so that the body of science is expanding towards the infinite and towards the infinitesimal.

"Among the lower animals the law of exercise is potent: the organ which is used is developed; disuse leads to weakness, decay, and ultimate loss. In human evolution the same method of progress by exercise is discovered to be one of the important factors.

"Through the inventions of mankind his mind has been developed. If we review the history of the human race, and fully comprehend what mental effort has been put forth to invent the arts of civilization and all the arts that have passed away by being superseded from age to age by better inventions, and fully grasp the mental efforts involved therein, we may comprehend that there is some good reason why the inventor of the electric light is superior to the inventor of the torch, why the inventor of the telegraph is superior to the inventor of the smoke-signal, why the inventor of the machine-shop is superior to the inventor of the flint-factory, why the inventor of the railroad is superior to the inventor of the dog-sled, why the inventor of the newspaper is superior to the inventor of a picture-writing on a bone. It has caused some exercise to bring about all the mental evolution which these differences implied."

This exercise of the human mind was further illustrated in the organization and re-organization of States, the enactment of laws to take the places of those that have been repealed, and in the establishment of courts. "To invent and apply human institutions, the mind of man has been forever at work, and out of this exercise has come a share of the evolution of the human intellect.

"Modern industries have been highly differentiated, or, the political economists would say, in modern industry there is great division of labor. By this division of labor men are made interdependent. No man lives for himself, but every man lives for others.

"When a man invents a new thresher, it is not that he may thresh his own grain, but that his neighbors may use it, that all the world may have it, and they, in return, may contribute to his happiness. If a man invents a new regulation or law, it is not that his own conduct may be regulated thereby, but that some injustice may be removed, or some justice be established, in the relations of the people of the State one to another. The farmer plants a field to raise wheat for his neighbors' bread, the gardener plants the vineyard to raise grapes for his neighbors' wine, the lawyer pleads his neighbors' cause, the physician gives nepenthe to his neighbors' pain, the poet writes for his neighbors' delight, the artist paints for his neighbors' gallery, and the philosopher expounds for his neighbors' instruction.

"All honest men are working for other men. If a man works exclusively for himself, he is a counterfeiter, or a forger, or a sneak-thief, or perchance a highwayman. All love of industry, all love of integrity, all love of kindred, all love of neighbor, all love of country, and all love of humanity, is expressed in labor for others. For this service thus performed a right to a reward is required, and he for whom the service is performed has imposed upon him the duty to render the reward, and the service is rendered in the hope of the reward. Everywhere in civilized society men are thus working for others. Every man, in all the years of his labor, toils for his fellow-man, and the practice is universal among all honest civilized men, and lasts from generation to generation; and universal practice is gradually becoming crystallized into universal habit. One man is trying to make better houses for his neighbors, another man is trying to make better shoes for his neighbors, another man is trying to make better laws for his neighbors, and another man is trying to make better books for his neighbors. Every man is thus forever dwelling upon the welfare of his neighbors, and making his best endeavor for their good; and thus the habit grows from generation to generation, until at last some men forget that there is reward for service, and labor for their fellow-men because they love their fellow-men.

"It has been seen that no man works for himself. The counterpart of this is that every man is dependent upon his fellow-man. That he may have good and abundant food, he desires the welfare of the farmer; that he may have good clothing, he desires the welfare of the manufacturer; that his rights may be maintained, he desires the welfare of the statesman, the jurist, and the administrator; that he may have the truth, he desires the welfare of the author; that he may enjoy poetry, he desires the welfare of the poet; and that he may enjoy art, he desires the welfare of the artist. It is thus that man is taught that he who loves the world loves himself, and he who hates the world hates himself. So it is that man toils for others and plans for their welfare, and others toil for him and plan for his welfare; so that every man's good is bound up with every other man's good, and every man's evil is an evil to every other man. And as man forever desires the good of his neighbor for his own sake, from generation to generation the desire for his neighbor's welfare for his own sake gradually becomes the desire for his neighbor's welfare for his neighbor's sake. Thus it is that selfishness is transformed into love, and justice and love are developed into the ethics of mankind. A part of the endeavor of mankind is governed by the principles of political economy, but the greater part is governed by the principles of philanthropy."

Major Powell then discussed competition among civilized men, which differs altogether from that competition which obtains among plants and animals. "It is a rivalry among men engaged in the same vocation to render a service to others that the reward may be received. Economic competition has or may have two factors, — emulation and antagonism. By emulation is meant the strife between men for greater excellence, — to perform better service for their fellow-men. By antagonism is meant strife in which man endeavors to injure his rival that he may himself succeed. Emulative competition results in human progress: antagonistic competition results in human retrogression."

The difference between these two kinds of competition was illustrated by the strife of artists to make the best pictures, by the organization of leagues or schools to instruct one another, and by such an appreciation of common interest in art as leads to great mutual help, and a comradeship that inspires to best endeavors. "Such generous emulation and all its products are in the line of human progress. But jealousies, unjust criticism, carping detraction, and vile slander lead to no progress among mankind. Every success in art creates among laymen an appreciation and love of art in every way beneficial to the artist himself. The natural man, in his ignorance, spurns all works of art. It is the cultured man that loves art; and the culture which brings appreciation and love of art arises from the ethical training which works of art give. In art, demand does not create supply, but supply creates demand. It is thus that the broad-minded artist rejoices in the success of his brother."

Further illustrations of emulative and antagonistic competition were drawn from the professional classes and from those engaged in agriculture. "The clientage of the latter is large and indefinite. The farmer is not striving to serve his neighbor Jones, but to serve the world. The farmers, too, are of great number; that is, there are many servants. For these reasons a farmer does not compete with his neighbor or with a number of specified or known persons, but his competition is with the whole body of farmers. For this reason, too, the spirit of antagonistic competition is never born: the competition of farmer with farmer is purely emulative."

These two kinds of competition were still further illustrated by the experience of the large body of people engaged in mining, manufacturing, and transporting industries. "Among them is both emulative and antagonistic. To avoid the evils of the latter, each class of employers is gradually organizing corporations or trusts; but by these, emulative competition is also avoided, for the managers of business enterprises no longer compete for business, but distribute business by convention. And in the same manner they repeal the law of competition in the labor market; they seek by convention to establish rates of wages. The employees in these same industries also compete with one another in two ways, — by striving to render their labor more efficient by skilled industry, and by offering to labor for smaller wages. The first method of competition is emulative, the second antagonistic. In all civilized society there is no competition so direful in its results, so degrading to mankind, as that which is produced among the

employees of these classes who compete for employment by cheapening labor, for it results in overwork which is brutalizing, and in want which is brutalizing; and the abolition of this form of competition is one of the great questions of the day. To avoid the evil, these people organize labor unions, but, while these destroy antagonistic competition, they also result in the destruction of emulative competition. The great problem in industrial society to-day is to preserve competition, and destroy antagonistic competition. The professional classes have already solved the problem for themselves, and they stand aloof and deplore the struggle; but they should learn this lesson from history: that, when wrongs arise in any class of society, those wrongs must ultimately be righted; and, so long as they remain, the conflict must remain; and when the solution comes not by methods of peace, it comes by war.

"Injustice is a strange monster. Let any body of people come to see that injustice is done them in some particular, though it may be one which affects their welfare but to a limited degree: they dwell upon it, and discuss it, and paint its hideous form one to another, until the spectre of that injustice covers the heavens, and gradually to that injustice the people will attribute all their evils. If a body of laborers receive unjust reward for their toil, they will dwell upon this evil so long, so often, and kindle their passions to such a height, that they will at last attribute to the failure of receiving a modicum of reward for their toil all the evils of their own improvidence, all the evils of their own intemperance, all the evils of their own lust; and if fire and flood come, the very evils of unavoidable misfortune will be attributed to the injustice of unrequited toil. Injustice is of such a nature that it must be destroyed by society, or it will destroy society. We dare not contemplate its existence with equanimity, for 'behold, what a great fire a little matter kindleth!'"

One of the most interesting illustrations of antagonistic competition given was that which exists in advertising. "The honest system of advertising should be but a small announcement of the offer of goods for the information of those who desire to purchase, in such a manner that those who desire to purchase, may, by seeking, find. But in advertising as it now exists, exaggeration is piled on exaggeration, and falsehood is added to falsehood. The world is filled with monstrous lies, and they are thrust upon attention by every possible means. The mails are filled with them. When a man opens his mail in the morning, the letter of his friend is buried among these advertising monstrosities. They are thrust under street-doors, and they are offered you as you walk the streets. When you read the morning and evening papers, they are spread before you with typographic display, they are placed among the items you desire to read, and they are given false headings, and they begin with decoy headings. They are posted upon walls, and on the fences, and on the sidewalks, and on bulletin boards, and the barns and housetops and the fences of all the land are covered with them, and they are nailed to the tree and painted on rocks. Thus it is that the whole civilized world is placarded with lies, and the moral atmosphere of the world wreaks with the foul breath of this monster of antagonistic competition."

In closing, Major Powell briefly reviewed the history of the land question in Great Britain, the conversion of the commons in England into the estates of nobles, until people learned that wanton extravagance of life is cured by elevating the poor to a higher condition, where they speedily learn the principles of prudential reproduction; and to-day, in that land, statesmen and scholars are devising the means by which those great estates may still be distributed among the poor. He also referred to the movements of wages among the laborers in Great Britain, their reduction to the lowest pittance on the plea in justification of the sanction of the immutable law of competition. Then there arose a philosophy which sought to ameliorate the condition of the poor people by charity. Still later a new philosophy arose, which taught that the wage-fund was limited, and was sufficient to supply only a limited number of workers; and so wages were reduced still lower, to be followed by strikes and riots, which threatened the beautiful isle with anarchy. "And now," said Major Powell, "another philosopher has arisen in the world, the great Herbert Spencer; and he has discovered another fundamental principle, a major premise, — that human progress is by 'the survival of the fittest in the struggle for existence.' That the fittest may survive, the unfit must die. Then let the poor fall into deeper degradation, then let the hungry starve, then let the unfortunate perish, then let the rich and the wise and the good and the strong live and flourish and propagate the race, then let the ignorant remain in his ignorance. He who does not seek for knowledge himself is not worthy to possess knowledge; and the very children of the ignorant should remain untaught, that the sins of the fathers may be visited upon the children. Let your government cease to regulate industries, and, instead of carrying the mails, let them erect prisons; let governments discharge their state-employed teachers, and enlist more policemen. Such is the philosophy of Spencer and his adherents. And they establish journals to advocate these principles, and edit papers to advocate these principles, and they have become the most active propagandists of the day; and the millions are shouting, 'Great is philosophy, and great are the prophets of philosophy.'

"Thus it is that fundamental principles, major propositions, are discovered to justify injustice, and yet forever man is endeavoring to establish justice. How this shall be done I know not; but I have such faith in my fellow-man, such towering faith in human endeavor, such boundless faith in the genius for invention among mankind, such illimitable faith in the love of justice that forever wells up in the human heart, that I swear by the eternal truth the problem shall be solved."

Density of the Earth.

The following is an abstract of a paper read by Mr. G. W. Hill at the last meeting of the Mathematical Section of the Philosophical Society: —

The relation which, according to Boyle's law, holds between the pressure and the density of the atmosphere or a gas under a uniform temperature, is so simple, that we are naturally curious to see the results of its application to the mass of the earth. The greater difficulty of the problem over that in which Laplace's law of density is employed may recommend it to us as a mathematical exercise.

The differential equation, which is satisfied by the density, is readily obtained by uniting the general equation of hydrostatics with the partial differential equation which the potential function at interior points satisfies. By certain substitutions the question is reduced to the integration of a differential equation of the first order and the subsequent quadrature. Unfortunately the first operation cannot be executed in finite terms, but the application of mechanical quadratures to the equation is quite easy. The differential equation defines a system of plane curves readily constructed by drawing their tangents at points suitably distributed. These curves fall into three groups, of which one takes up the space to the right of the vertical axis of co-ordinates, and is the only one applicable to the physical question under consideration.

A first illustration of the general theory is afforded by treating the density of the atmosphere considered as surrounding a spherical earth, in which one does not neglect, as usual, the attraction of the atmosphere on itself.

Passing to the problem afforded by the mass of the earth, the construction of a single one of the formerly mentioned group of planes, and the summing of a definite integral along its line, is seen to contain the solution of the whole matter.

A general table is then formed, from which we can obtain all the data needed for applying the general theory to any particular case.

Assuming the surface density as 2.7, and the mean density as 5.67, the density at the centre comes out 21.7, and at half the surface radius 9.4.

If the mean density is more than fifteen-fourths the surface density, there is no solution.

If the mean density is exactly three times that at the surface, the number of solutions is infinite.

For the case of the earth considered above, there is only one solution.

Submarine Oil-Springs.

The Hydrographic Office publishes upon the Pilot Chart for March some late information concerning submarine oil-springs on

the Pacific coast. The best known of these is off what is known as 'Coal-Oil Point,' about one and one-fourth miles west of Goleta, and ten miles west of Santa Barbara. Captain Van Helmes, of the American steamship 'Los Angeles,' says that when a vessel passes through this region the smell of the oil is so strong as frequently to cause nausea among passengers and crew, and in certain spots the oil can be distinctly seen bubbling up on the surface. Captain Wallace, of the American steamship 'City of Chester,' has also seen oil floating on the water to the north of Cape Mendocino, from three to five miles off shore, and thinks there is another spring there. Captain Plummer, of the American steamship 'Gipsy,' says the belt of oil above Santa Barbara can be seen on the darkest night when sailing through it. Captain Goodall, of the Pacific Steamship Company, says of the region off Coal-Oil Point, that on a calm day the water is covered for miles with oil, bubbles of which can be seen rising to the surface and spreading over it. Although it does not seem to smooth the water like animal oil, yet, on a windy day, one can see a smooth slick of oil on the surface. This spot is so well known by shipmasters, that the smell of the oil is used as a guide in foggy weather, the petroleum smell being so strong that a captain can never mistake his position when off that point. Captain Goodall says, also, that he has noticed a small flow of oil from the bottom of the sea off Cojo Point, near Point Conception, but there the amount of oil is very small. It cannot be seen bubbling from the bottom, but is often visible on the surface, the odor being very perceptible.

HEALTH MATTERS.

Scarlet-Fever.

THE following striking instance, illustrating the communicability of scarlet-fever, is sent us by Dr. George E. Goodfellow of Tombstone, Arizona, in answer to the letter of inquiry sent by *Science* some months ago: —

"I came to Prescott, Arizona, in 1876. At that time I was informed by physicians residing there for a number of years, that, to their knowledge, no case of scarlet-fever ever had been known either in the town or surrounding country. Prescott is a pleasant little mountain town of central Arizona, and at that time had a population of about eighteen hundred, and had been then, and is now, considered to be unusually free from disease. The altitude is about 5,800 feet. There was no sewerage system, nor was one needed. In this climate of the South-West, owing to the dryness of the atmosphere, excrementitious material desiccates so rapidly, and the residents are so unaccustomed to the vile odors of civilization, that they never have realized the necessity of supplying the pabulum of putrefaction, in the shape of water, to their sewage. There was not a foul-smelling outhouse in the town, save around the saloons and some restaurants; and there, be it noted, no one lived; neither was any one there, taken sick in the epidemic, to be recounted. I speak thus authoritatively of the condition of the village, for I was appointed health-officer, therefore knew the state of things. One more preliminary statement. Of the people living in Prescott and the encompassing neighborhood, almost all were considered as old residents; that is, they had emigrated to Arizona about 1862–64, mostly from the Pacific coast. There was comparatively little immigration into the Territory from 1868 to 1876–77. By reason of this, the children imported from California left that State before the advent there extensively of scarlet-fever and kindred diseases, and were now grown to manhood and womanhood without ever having had any of the contagious diseases of childhood. Many of these, particularly the girls, were married and had children; and it was among these children that the disease which proved so fatal started. Whatever the differences of opinion concerning the first cases, which made their appearance in May or June, 1877, the nature and malignancy of the fever were soon conceded by even the most sceptical. It was scarlet-fever in its most malignant form, and, if I recollect aright, it swept away between twenty and thirty children in that small burg before it ceased. But it was not confined to the children: the parents, particularly the young mothers, as described above, contracted the fever in all grades of severity, though usually in a mild form. There was a family, prominent in the place, with three children, aged from two to eight. I was the medical attendant. The eldest contracted the disease first, and in a few days the others had it. Two of them died about the seventh day, — the two younger ones. The other ultimately recovered. Owing to the popularity of the family, a large number of visitors, sympathizing friends, and curious neighbors, as is usual in small towns, had filled the place, spite of all protests from the physician, from the beginning of the trouble until the sad ending. Of the immediate friends, a large number were of the younger class heretofore described, that never had had scarlet-fever. Of these, the majority were taken down with some form of sickness related to the disease. Most of them had the fever outright, but some only had severe sore throats. The father, mother, consulting physician, and myself were all attacked. Whether I ever had had the fever, I do not know. The father, two young men, and myself, who had been closely in contact with the children from the beginning of their illness, lay at the point of death for some days; and, of all who were in the house, not one escaped without some manifestation of the disease. Thus effectually was the fever spread. It seems to me this is a striking illustration of the communicability of the disease. Of course, the objection may be raised, the sanitary conditions of the house were not good. But they were. The house was a new one, a year old, of wood, set up from the ground by short two-by-four scantling, so that the wind had an elegant chance to ventilate the building. There was no cesspool, or foul locus of any sort, in the neighborhood. It was, in fact, an ideally clean place. Some of those who had typical cases of the fever were twenty-four and twenty-five years of age.

"Now, here was an epidemic, which, so far as we knew at the beginning, had no antecedent case to initiate it. My subsequent investigations settled that point. It was ascertained that the previous year, at Fort Whipple, an army post near the edge of town, there had been some cases of what the post surgeon pronounced scarlet-fever. Thus died the case of the *de novo*ites. At any rate, the *onus probandi* of origin was put on the preceding year's cases. Where they came from, never was shown certainly; but as some families had recently joined the station, coming from infected points, it was a natural supposition to conclude that they brought it with them. This is the strongest concatenation of circumstances, derived from personal observation, I can give. I have not entered into details showing absence of other sources of contagion in the persons attacked. This must be assumed as having been established at the time."

VACCINATION STATISTICS. — The following extract from *The Sanitarian* would seem to indicate that a compulsory vaccination law has its advantages: "The success of the anti-vaccinationists is aptly shown by the results in Zurich, Switzerland, where for a number of years, until 1883, a compulsory vaccination law obtained, and small-pox was wholly prevented (not a single case occurred in 1882). This result was seized upon in the following year by the anti-vaccinationists, and used against the necessity for any such law, and it seems they had sufficient influence to cause its repeal. The death returns for that year (1883) showed that for every thousand deaths two were caused by small-pox; in 1884, there were three; in 1885, seventeen; and in the first quarter of 1886, eighty-five."

BLOOD-CHANGES. — The Paris correspondent of the *New York Medical Journal* says that the application of spectroscopy to the study of pathological alterations in the blood is receiving considerable attention in that city. So far, the considerable expense of the large instruments employed has to a great extent prevented any use being made in medicine of the principal characteristics of the coloring-matter of the blood, either in the normal or in the pathological state; but a late invention of Dr. Hénocque's places in the hands of the medical profession a handy, portable hæmato-spectroscope, that will almost go into a waistcoat pocket, and with which a spectral analysis, both qualitative and quantitative, of hæmoglobin and its derivatives (oxyhæmoglobin, methæmoglobin, etc.), can be made at the bedside. But it will be asked, What is the advantage of knowing this? Well, it has been proved to be of the utmost importance in the study of the variations of the activity of the reduction of oxyhæmoglobin in health and in disease. This Dr. Hénocque makes us *see* with his instrument applied to the thumb. A small elastic-band ligature is tied around the lower part of the thumb, and on the