

SCIENCE

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SCIENCE AND INDUSTRY¹

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THE present age surpasses all previous epochs of history by the intense activity of the human race, the daring of its efforts, the magnitude of its accomplishments.

We know of periods in history where great wars, great political developments, migration, religious fervor, newly discovered lands, or other causes, brought forth considerable changes in some nations, but never was the movement so wide-spread in geographical location, never were impulses operating so rapidly, nor on so extensive a scale, as to-day.

We have not reached the end of this movement; quite on the contrary, it seems to gain in intensity as the years roll by.

While some few nations have taken the lead in certain lines of human endeavor, we know, on the other hand, that the same influences are at work even in the most remote corners of the world; countries which for ages have been dreaming dreams of rest, countries of which the political, intellectual, social or industrial conditions have remained practically unchanged for hundreds, nay thousands of years, begin to awaken; willingly or unwillingly, they too seem to undergo, albeit in a smaller degree, this all-pervading tendency of enterprise, this aggressive effort to better utilize their opportunities for material, social and intellectual betterment.

In other words, modern human dynamics have reached an intensity never witnessed before.

It looks to me as if all great feats re-

¹Address of the president of the American Electrochemical Society, Pittsburgh, May, 1910.

corded in the history of our race sink to nothingness if compared to what human activity is accomplishing every day since ignorant, arrogant, emotional, spasmodic efforts are slowly but surely giving place to methodical and persistent work based on exact scientific knowledge.

Whether the human race has been made happier by all this, I shall not here try to decide. Happiness is a very subjective condition of mind, very difficult, if not impossible to measure or to compare: the happiness of the child or the savage and the happiness of the intellectually developed adult are two entirely different propositions. I believe, however, that even case-hardened pessimists ought to admit that our *opportunities for happiness* have considerably increased, even if so many people, not knowing better, continue to trample upon these very opportunities, blinded as they are by false ideals, or by misdirected aspirations.

True, the pessimist may point to the slums of large cities, to poverty, to vice, to unsatisfactory labor conditions, to high cost of living. But, what is all that compared with conditions in bygone ages? Where are the famines, the plagues, which not so long ago periodically devastated Europe, and which are still the scourge of some backward countries like India, China and Russia?

Political corruption, dishonesty and greed are still too much in evidence, and there is much room for higher ethics; on the other hand, anybody who wants to give himself the trouble to investigate real history will have to admit that the morals and conduct of life of many of the most exalted personages of the past, would fall far below the test of the plain average decent citizen of our republic to-day.

Most certainly, there is still abundant necessity for improvement; and our race

will improve as long as we put more pride in raising better children than in finding an excuse for our littleness or a consolation for our failures, by bragging about the supposed importance of our ancestors.

Nowhere have the changes of this century been so accentuated as in our industrial enterprises. We know, furthermore, that just such industries, where the developments have been most staggering, are exactly those which have utilized scientific knowledge to the largest extent. Wherever the engineer has been able to put into practise the secrets which the scientist has wrung from nature's laws, there also do we see results so far in advance, as compared with what existed formerly, that only a man with a dead soul fails to be stirred up to admiration and enthusiasm.

The modern engineer, in intellectual partnership with the scientist, is asserting the possibilities of our race to a degree never dreamt of before: instead of cowering in wonder or fear like a savage before the forces of nature, instead of finding in these forces an object of superstition or terror, instead of perceiving in them merely an inspiration for literary or artistic effort, he learns the language of nature, listens to her laws, and then strengthened by her revelations, he fulfills the mission of the elect and sets himself to the task of applying his knowledge for the benefit of the whole race.

Let me assert it emphatically; the two most powerful men of our generation are the scientist and the engineer.

Society at large is far from realizing this fact, simply for the reason that the scientist and the engineer manifest their power not as despots, not as cruel tyrants. Their might is not put in evidence by the amount of chattel-slaves they hold in bondage, nor by the barbaric splendor of their lives; it is not marked by the devastation

wrought by armies; their work does not consist in conquering and subjugating weaker nations; we do not see them, glorified in painting and sculpture; we do not hear their exploits extolled in song and rhyme; no artists have had to record their triumphant homecoming, greeted as saviors and heroes while marching over the mutilated corpses of their fallen enemies; they do not use their power to sow sorrow, death and misery, or to steal and plunder or fill the museums of a city like Paris with treasures of art taken by force from weaker nations. No, the masses are unaware of the immense power of the scientist and the engineer because both of them modestly play the rôle of "the servant in the house"; their unassuming life is devoted not to slaughter, destruction or coercion, but to the service of mankind. They do not build useless pyramids cemented with the sweat and blood of overabundant slaves, monuments to vain glorious despots, witnesses to the small value which was put in ancient times on human life and on human labor.

But the modern engineer, applying the principles of science, raises buildings far superior in size and conception than any architecture of bygone ages can boast of; edifices incomparably more comfortable, more hygienic, more appropriate than anything built before. He raises those gigantic structures in as many days as it took years to build a temple.

In fact, after a few years, he is ready to pull the same buildings down, to erect better and bigger ones in order to suit advanced conditions, and nobody cares about the name of the architect or the engineer, nor does the builder care himself.

And why should anybody care? The dynamics of the age are producing changes at such a rapid rate, that nowadays any building, of whatever size it be, is begun

with the feeling that before long it will have to come down to give place to new conditions. Erecting a twenty-story building in a city like New York is about like putting up a temporary tent, which may suit us for a while, but has to be taken down whenever conditions, in the onward march of civilization, demand it. Palaces and other buildings which would have made the pride of older nations are torn down now after a career of less than twenty years, to make room for the development of our cities, to allow larger and better adapted edifices to take their place, which probably in a relatively short time will follow their predecessors and be torn down in their turn, when our children begin to realize that they want streets four or five times wider than our now overcrowded thoroughfares.

The modern engineer and the scientist realize that much more enduring monuments than stone, brick or bronze will mark the work of this period: they know that the diffusion and application of exact knowledge is shaping the destiny of future generations and will afford more lasting evidence of their efforts than temples or statues; they believe that their work will not count merely for material betterment, but that improved material opportunities created by them will bring forth better people, higher ideals, a better society.

To put it tersely, I dare say that the last hundred years under the influence of the modern engineer and the scientist have done more for the betterment of the race than all the art, all the civilizing efforts, all the so-called classical literature, of past ages, for which some respectable people want us to have such an exaggerated reverence.

Consistent in their mission of true powerful men and of servants of our race, the

engineer and the scientist perform their work steadily but quietly; they are not appreciated by the unthinking multitude because of the fact that their modesty is usually as great as their achievements.

True, I know some of them who do not exactly "hide their light under a bushel"; but show me the most vain engineer or the most conceited scientist and he will appear like the very picture of meekness and modesty if you will put him alongside some artists, some writers of fiction, some opera singers, or opera composers.

Let me insist on the fact that every one of our betterments in material conditions, every increase in our opportunities in life has been the entering wedge of vastly improved social, political and ethical changes.

The steamships of to-day, to which the armadas of yore and the fleets of antiquity look like mere children's toys, bring distant nations, distant men, nearer together; so do the railroad, the press, the telegraph, the telephone.

Not only have time and distance been shortened by the industrial applications of science, but life has been lengthened in years, and still much more in accomplishments and in opportunities.

Improved means of communication do not only facilitate the exchange of products between far-away nations, and allow them to compete in quality and price in the most remote corners of the world's market, but they enable more lasting exchanges than merely those of material commodities; we intermingle, develop and distribute thoughts and knowledge which slowly but surely modify and perfect the political and ethical conditions of nations as well as of individuals.

Not so long ago, opportunities for travel, for education, wealth or comfort of existence, were given only to a very few; now in our modern community all these advan-

tages have come within the reach of the multitude, and all this, thanks to our industrial developments.

Much has been said and written about the civilizing influence of the discovery of the printing press. Has it ever occurred to you that the printing press could accomplish very little if we had not invented the means for manufacturing cheap and good paper? In the same way, every facility which science and engineering has endowed the world with finds itself reflected in the ever-increasing development of printed publications. For one book that was written a few centuries ago, thousands, and better prepared ones, are published nowadays. Ancient authors had few competitors and few readers, and the latter could afford to remember the names of their authors, and greatly exaggerate their merits, and overawe following generations with the extent of their importance and hypnotize some of us into the belief that there are no good authors but dead authors, or ancient authors, an opinion unfortunately shared by some respectable pedagogues.

To-day, when illiteracy is no longer the rule but the exception, new ideas, new conceptions are carried to all points of the globe: measured, discussed, hacked to pieces, or developed, all this with a rapidity never attained heretofore; and I believe that one of the most important causes of our rapid mental and industrial progress is due to the very swiftness with which information and knowledge penetrate the masses.

The man who nowadays would try to stem the tide of ideas, or intellectual advance, would only succeed in making himself ridiculous.

In the middle ages, some devout people, not knowing better, could try to burn scientists and their books, and opposed for

a while the march of progress, because there were so very few scientists and so very few books to burn. But nowadays it would require more than all the combined blast furnaces of Pittsburgh to keep up this process of oxidation.

It helps a country like Russia very little to have some highly developed men, some great scientists, great philosophers, as long as the multitude of the rural population remain in ignorance and lowness; as long as so many people are prevented by unsatisfactory material conditions to profit by the influence of their better fellow men.

In a self-respecting community the benefits of modern conditions and opportunities for advancement are open for everybody and privileges of birth and class are now considered an anachronism, if not a crime, against the human race. Yet few men stop to compare the conditions of modern life with those of the good olden times. An average man who thinks himself underpaid and imagines he is living at a very modest pace, does not realize that when he is traveling in a modern railroad train he enjoys comforts and advantages never dreamt of by the richest or most powerful men, princes or kings, of scarcely a century ago; he forgets that his life is surer, that his health is better taken care of, than that of any potentate of former times; that the nation respects more permanently his rights as a citizen, than was the case of prime ministers of one or two hundred years ago; that his sons and daughters have better and surer opportunities of education and intellectual advancement, than the children of kings of past centuries; that there is no beautiful thought in this world, no knowledge, which is not accessible to him and everybody who can read.

Man only considers a thing a luxury as long as his fellow men can not get it, never

mind whether it be a bit of glass or a diamond, a bicycle or an automobile; commodities of modern life cease to be considered as luxuries as soon as they become easily accessible to everybody.

Neither should we be too much disappointed in meeting so many people who seem to be oblivious to our improved conditions, as compared with those of former times. Society has been pushed ahead, against the will of the masses, by a few active, daring, restless men who forced the others to follow; just like a herd of unthinking sheep is unwillingly driven forward by the shepherd and his dogs. Many people among whom we live have truly been prodded into progress; they may properly be called remnants of bygone times, symptoms of mental atavism of the race; they do not properly fit in our age; they have passively drifted along on the advancing stream of centuries to be carried beyond where they properly belong, and now they constitute the ballast which impedes the dynamics of our modern generation.

It has been asserted so often by respectable people that science and industry cater only to our material welfare, and have little in common with culture, refinement or moral development; therefore I feel compelled to put special emphasis on this side of the question and to insist on the enormity of this error; on the contrary, the development of our industries, of our material prosperity, as well as the study and application of science, are the surest and most immediate forerunners of higher civic ideals, of an improved society, of a better race.

A clean, well nourished and well housed individual who can enjoy the comforts and advantages of modern surroundings, and leads an active, intelligent, productive, self-supporting and self-respecting life,

is certainly more of a man and a credit to his race than were some ancient saints who lived from alms and who spent their life in prayer and inaction, or who, for further edification of their followers, vowed never to change their clothes, nor wash nor shave nor comb themselves; he is more of a blessing to his fellow men than the useless drone who lives on the work of others and gives nothing in return but arrogant presumption based on fortune, rank or title inherited from his father.

If this be then the age of rational industrialism, of applied science, how then is it that in some industries quality is going down, while prices are soaring upwards?

Here again it is a noteworthy fact that just such commodities as are produced by so-called scientific industries are sold cheaper and are of better quality than ever before, and this cheapening of price or bettering in quality is almost proportionate to the amount of scientific knowledge involved in their production. Let us take, for instance, the chemical and the electrical industries, both based almost exclusively on well-developed scientific data. In both these groups of industries the chemist or the physicist has had full sway and the engineer has embodied their work in a practical form. Free and rational competition based on intellectual superiority has been their paramount factor of development. Competition based on artificial privileges like labor unions, tariff legislation, have played only a secondary rôle. While flour, meat, clothing and houses were considerably less expensive a hundred years ago than they are now, we find that acids, alkalies, salts, solvents, dyes, and, in general, almost all chemicals, are incomparably cheaper and of better quality than they were in the good olden times.

In some cases, the changes are remarkable. For instance, a ton of sulphuric acid sells now at the same price as two pounds of the same article were sold about a hundred and fifty years ago.

A similar cheapening can be found in many other chemicals, although their demand has immensely increased. Without going to extreme cases, we can state that there has been a steady improvement in most chemical manufacturing processes and that the public at large has had the benefit thereof. The same can be said of the electrical industry.

Compare this with industries which are still under the sway of the rule-of-thumb, which means the rule of the ignorant, or where competition is based on political protection; you will find that just such rule-of-thumb commodities where science plays no rôle, are those for which the public has to pay the highest price in return for the poorest article. Married men may follow this assertion from butcher's bills to ladies' hats, from house rents to servant girls.

For the poor chemist, it is almost an irony of fate that his science, by developing the "cyanide process," made gold cheaper and thereby reduced considerably the purchasing equivalent of his meager salary. In order to get square he will have to put himself now to the task of helping the engineer in the cheaper production of foodstuffs, or clothing, or take a hand in such tax reforms which may bring about a reduction of rent or may lessen other economic anomalies.

Notwithstanding all our progress, it is evident that we live in a transitory stage; next to enterprises and industries embodying the highest intellectual conceptions our century can offer, we find even in the most advanced countries examples of conditions

of affairs which seem truly an anachronism.

This must have impressed many of you who have happened to visit factories or mills where ignorance and greed seemed the two dominant factors, where the class of men and women employed, not to speak of child labor, seemed to have undergone the full curse of their sordid surroundings. Such places are to be found often where the mental condition of the directors does not enable them to go beyond the conception of size and where the whole tendency has been towards more, more, more, instead of towards better, better, better.

How different is this from some of our better engineering and chemical enterprises where everything bears the imprint of a steady effort towards progress and where employer and employed alike seem to undergo the uplifting force of intellectual aims. Such a happy condition of affairs is most likely to be encountered where the head is himself the scientific pioneer who has built up the enterprise.

Matters are not always so satisfactory where large organizations have got into the hand of a board of directors, who know little else of the technical side of the business than that it pays dividends, and for whom the main interesting factor is the value of the shares they own.

Whenever undertakings are ruled by such a class of men, we must not be astonished if their corporation counsel is more in evidence than their chemists or their engineers. What do they care if certain improvements in their processes might net them five per cent. more or mean better goods, if, on the other hand, they know that by a clever trick of law they can extract from the consuming public many times more; no wonder then if they have less time and less mental fitness for a principle of science or engineering involved in

a new process, than for a conference with "eminent law counsel." If they can not alter nature's atomic weights, they may find a way of improving their invoice weights for the custom house to the detriment of Uncle Sam. I might use for our industries the forceful quotation of Shakespeare in Hamlet about the state of Denmark, as long as corporation lawyers of reputation are paid incomparably better and their services are sought for so much more eagerly than the very best chemists or the ablest engineers.

This brings to my mind the case of a company which held a charter to supply a certain city with illuminating gas, and which after enjoying a fortune-making monopoly for many years, found one day that special legislation had reduced the selling price of their product. Certain again of being able to upset this law, the company entered in long litigation, but finally, after repeated efforts, had to realize that even its best lawyers could not change matters. From that moment on, they began to inquire actively about better manufacturing processes. A friend of mine, who was requested to give his suggestion as to how they could improve their methods, replied as follows: "Up till now your company has been making *law*—now make *gas* and everything will come out all right."

Then again we find that, resourceful as the modern engineer or chemist is, his power is often simply a tool in the hands of ignorant but cunning men. In fact, our modern laws and society insure better reward for cunningness or slyness than for true intellectuality.

The very abundance of our natural resources may be partly to blame for this condition of affairs; in other countries, like Germany, with comparatively small natural means, competition shapes itself more

towards technical perfection. If we want to learn how to reduce what I would call our "nation waste," our German friends can give us valuable lessons. It is significant too that in large German engineering or chemical enterprises the board of directors is made up mostly of scientifically trained men, engineers, chemists and physicists. The entrance of the physicist in our industries has not yet become very evident, although in Germany it seems to be the rule, especially in electrical and other enterprises, to give to the physicist as much importance, and even more, than to the chemist; both of these scientific specialists leave the purely engineering problems to the qualified engineer.

The story was told to me how the head of one of the largest engineering firms in Germany won his spurs. Prices of copper were rising beyond precedent, and his merchant business associates insisted therefore that he should buy an amount of copper sufficiently large to supply them for their electric installations for several years to come. In the meantime, prices were going up faster and faster; but this did not seem to disturb the scientific director, who was eagerly following the results of some special research work, giving reliable data about transformers and high voltage transmissions. As he understood the law of Ohm, he knew that pretty soon, even if copper was three times higher in price, he could use so much thinner wire and save money in the end. What he foresaw happened; the price of copper dropped suddenly, and Ohm's law triumphed over copper speculators.

All this does not take away the fact that although some industries suffer from brutal ignorance, others have sometimes been handicapped by a too one-sided scientific organization; I know of some instances, especially in Germany, where very

respectable enterprises have not utilized their available opportunities to the proper extent, because their scientific managers lacked good business sense. I have seen some industrial enterprises much held back by too much red tape and a choking amount of paper-wisdom. The most learned man without common sense or practical abilities can accomplish little except disappointments. Here is where the keen business man, with a practical turn of mind, with directness of purpose and good judgment, will every time show his advantages.

An overspecialized man, whether he be a biologist, a physicist, a chemist or an engineer, may lack the broadness of conception and action which characterizes true great men of many-sided development.

Then again, quite frequently the real field of usefulness of scientifically trained men is much misunderstood. For instance, it is a common mistake, made even by some engineers and physicians as well as by business men, to imagine that the main work of the chemist is confined to performing chemical analysis. This conception is about as absurd as to think that the main usefulness of an electrical engineer consists in making electrical tests, or that the essential work of the merchant is bookkeeping.

Many a good chemist has been thus prevented from showing his best abilities by the sheer ignorance of those who employed him.

In the development of some of our industries, nothing has played such an important rôle as scientific research work. To those who do not realize this, let me tell that not so long ago I had an opportunity in Philadelphia, to see that old electric machine of Benjamin Franklin, a small revolving glass globe mounted on a

wooden frame; this was about as far as electricity went a century ago. Shortly afterwards, I was confronted by those gigantic electric installations at Niagara Falls. To those who belittle the value of scientific research, I recommend a comparison between this and Franklin's machine, a mere scientific toy, a clumsy affair, that would at its best performance, and if the weather was not too damp, give off some small sparks; a contrivance so useless in its time and so devoid of apparent practical applications, that if some one had told to a "shrewd business man" of last century, what this field kept in store for us, he would merely have shrugged his shoulders in derision. But now behold the hundreds of thousands of electrical horsepower developed in those monstrous generators of Niagara Falls, sensitive as a slender nerve, and yet running with the precision of a watch; distributing power and light to distant cities like Toronto and Syracuse; running heavy railroad trains as surely as the tiny drill of the dentist; converting ores into metals; transforming hundreds of tons of brine daily into caustic soda and bleach; changing mixtures of sand and coal into carborundum; ennobling plain coal into graphite, or producing from coal and limestone new sources for illumination under the form of calcium carbide; or again fixing the nitrogen of the air on calcium carbide to change it into cyanamide, a most valuable synthetic fertilizer; and at every succeeding year, new chemical achievements of this kind are still being brought forward by a set of tireless workers.

Let me ask a fair question of those who underestimate the value of research: Has that stupendous gap between Franklin's toy and the power companies of Niagara Falls been bridged by anything but by scientific research of the highest order?

Some of the better educated people in this country begin to understand more and more the necessity of scientific research. Not so long ago, research work was only carried out in the laboratories of universities or in those of a few highly developed chemical or electrical companies; nowadays we find many intelligently conducted enterprises devoting a considerable annual outlay for systematic research work, where the resources of the chemist, the physicist and the biologist are used to good purpose.

Unfortunately, the scope and method of scientific research is difficult to understand for the uninitiated. Some people have only the haziest conceptions on this subject. Some manufacturers, totally unaware of the requirements involved in this work, in a half-skeptical way, grudgingly conclude to organize a research department, sometimes as a last resort to help them through some difficulties; others do it "to be in style" and simply to imitate their more successful competitors. Frequently they engage a young man with little experience, who, outside of what he studied in the technical school or at the university, has everything to learn, and who, besides that, is usually entrusted at the very start with the most difficult problems. His salary is none too high, and his action is very much restricted; sometimes he is forbidden to study the current practical methods, or so-called "manufacturing secrets," and is thus prevented from getting acquainted with the very problems he is supposed to solve. I have seen other cases where the time of the research chemist was filled with odd jobs of every kind. After a while, when practical results are not forthcoming fast enough, the book-keeper confronts him with the list of expenses which have been incurred by his work; naturally some comments are ready at hand how the same money spent on a

good salesman would have shown immediate results, and so forth. Things go along that way for a while until the research department is abolished with the recurring remark: "Research does not pay, we've tried it."

In other cases, where some results are obtained, the matter is taken out of the hands of the chemist before he has had time to fairly try and develop it on a large scale. The subject is now entrusted to the superintendent or the foreman, who seldom is a friend of the scientifically trained man, and nearly always resents anything which might diminish the prestige of "established practical experience." Like in all new processes, defects are soon shown, and in the natural order of things, repeated failures and renewed trials on a practical scale are required before there is any possibility of regular utilization. The research chemist is allowed very little intervention at this stage of the work, and often, remarks are heard how imperfect the whole thing was "before so-and-so, the practical man, had his say." Finally initial expenses are charged against the research department, and profits credited to the "practical man."

A research department is a very difficult thing to organize and to run. It is not enough to provide a building and the necessary appliances; it is not enough to provide typewriters, card-indexing systems, and office force, and all the red tape connected with it; it is not sufficient to engage one or more well-behaved university- or college-graduates with the necessary helpers, and to let them work under an orderly businesslike manager. You might as well try to produce masterly paintings by installing an office management and a well organized paint and brush department, and a library containing all that has been written on the art of painting next to a

splendidly equipped studio, and then leave out the real artist who will do the painting. Nay, the most important, the almost exclusive factor in a successful research laboratory is the research chemist himself. If he is not a man who has a soul alive with his subject, if he is not enthusiastically imbued with his opportunities, if he is not qualified for his task not only by scientific training but specially by a natural gift of discrimination between what is most important in a problem and what is secondary to it, you might as well fill a hall with the marble statues of Greek poets and imagine that they will write poetry for you.

Then if you find the man who has all the true qualifications, you may still paralyze his action by too much red tape, too much interference in his work. A good research chemist will do more and better work with pots and pans from the "ten-cent store" in a shed or in a barn, where he is his own master, than in a splendidly equipped laboratory where he gets irritated and interfered with by others who do not understand him.

I sometimes doubted whether it was really worth while for a young man to take up research work single handed, when so many people with abundant facilities were at work. What show, for instance, does an organic chemist have in studying a problem for which in Germany some large chemical companies employ hundreds of research chemists. To this I can answer that some of the most striking examples of successful research were the result of privately conducted work with modest means; in fact, I know of several instances where a research chemist who had created himself a reputation by work carried out privately under adverse circumstances, showed disappointing results as soon as he became part of a vast organization.

Even if you have the best qualified research chemists, do not expect immediate results. Do not forget that problems, appearingly most simple, require considerable time before they are thoroughly studied. Even in successful cases, it may easily require many, many years before a subject is so thoroughly elucidated that it can be taken up in practise.

Research is what gives a young man of strong individuality a chance to compete with those big industrial consolidations, the trusts, who, like elephants, look more imposing by their size than by their agility or perfection, and who, as that pachyderm, have many vulnerable spots, and are just as much handicapped by their lack of flexibility and by their ponderosity. Some steel manufacturers may be unable to think about anything but tonnage, and yet the work of some chemists has already indicated that the quality of steel of the future, or of its alloys, may be improved to such a degree that probably the average steel of to-day will look to our children as brittle and imperfect as pig iron appears to us. Neither should we lose sight of the fact that even to the most exclusive mechanical enterprises there is a chemical side, although the importance of the latter may not be apparent to the man who is not a chemist.

Let me give also a warning to such manufacturers who try to secure only by uncompromising secrecy, the money-making end of their industries.

As far as my experience goes, exaggerated secrecy is very often an indication of lack of knowledge, of industrial feebleness and incompetency; a miser is most of the time a man of small means.

If the chemists had been holding their results from each other, we should still be in the dark ages of the alchemist. No secrecy, however jealously carried out, can

outweigh enlightened research work, protected by wise patent legislation. If our patent laws do not protect enough, then our prime duty becomes to change them until they answer their purpose as defined by the constitution of the United States. The care with which patent laws are administered is a direct measure of the industrial importance of a country. Piracy can not flourish, neither on the seas nor in intellectual property, if ethics of justice and equity can be made to prevail.

Every recorded success of the scientist or the engineer is an additional evidence that ignorant greed and brutal rapacity can not forever have full sway in this world, and that the rule of the sly and the shy leads to the abortion of progress. Furthermore, the results of their work, which bars out "chance," "luck" or "happenings," is their most eloquent language to convince their fellow men that if law-makers may still think that laws are made or unmade by them in Albany or Washington or Harrisburg, there is at least one law which can not be amended; at least one law which even the cleverest lawyers can not make to be interpreted in two different ways; a law which rules all men, large or small, poor or rich, to whatever nation they may belong; a law which rules the dead, and the unborn as well as the living; a law which requires no supreme court to test its validity; a law that can not be trifled with, which nobody and nothing can escape: the great unchangeable Law of Nature which rules the universe, mocks at men-made statutes and ordinances, and upsets and destroys everything which comes in conflict with her; the rigidly enforced law which tries to teach us our mistakes by suffering, by misery, by industrial or political crisis, by unhappiness, by war, so as to awaken us from our ignorant sleep, to show us our

misguided aims, and to command us to prepare a sounder, a happier condition for our children and future generations, while building up, during the trend of centuries, a slowly rising foundation for a higher humanity, a more god-like race.

LEO HENDRIK BAEKELAND

THE GENERAL EDUCATION BOARD

At a meeting of the trustees of the General Education Board, held on May 24 in New York City, \$682,450 in appropriations was voted. Of this sum \$538,000 was appropriated conditionally for the endowment funds of eight colleges, \$113,000 for the furtherance of demonstration work in agriculture throughout the southern states, and \$31,450 for the salaries and expenses of special professors of secondary education in the several state universities of the south.

The appropriations voted in support of college endowments raised to \$5,177,500 the sum already spent in this direction. The seventy colleges that have received these endowments during the last four years of the board's activities have each raised sums in endowment which taken with the board's gifts aggregate \$23,670,500.

Conditional appropriations for endowment were made to these colleges in the following sums:

Cornell College, Mount Vernon, Ia., \$50,000 in addition to a like amount subscribed at the last previous meeting of the board.

De Pauw University, Greencastle, Ind., \$100,000.
Marietta College, Marietta, O., \$60,000.

Allegheny College, Meadville, Pa., \$100,000.

Central University, Danville, Ky., \$75,000.

Drake University, Des Moines, Ia., \$100,000.

Middlebury College, Middlebury, Vt., \$50,000.

Transylvania University, Lexington, Ky., \$50,000.

These eight colleges were selected from a list of twenty-nine who petitioned the board for assistance.

The sum of \$113,000 appropriated for demonstration work in agriculture in the south was made in the furtherance of the efforts which Dr. Seaman A. Knapp, of the Depart-

ment of Agriculture, is making in elevating agricultural conditions through the southern states by teaching intensive farming and the scientific methods of crop raising. In giving financial aid to this movement the General Education Board is cooperating with the department at Washington. Last year the board's contribution in this direction was \$102,000, which was divided among the various states as follows: Florida, \$5,000; Georgia, \$32,000; South Carolina, \$22,000; North Carolina, \$24,000; Virginia, \$22,000. In addition \$8,000 was spent in the administration of this enterprise.

The money voted by the board for the salaries and traveling expenses of professors of secondary education in the south is to be spent, as previous appropriations have been, in fostering the growth of high schools. The board now has one such professor attached to the state universities of Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee, Louisiana, Arkansas, West Virginia and Kentucky, provision for the last of which was made at the meeting. The sole duty of these professors is to urge throughout their several fields the establishment of high schools.

The trustees of the board who attended the meeting were Frederick T. Gates, Robert C. Ogden, Walter H. Page, J. D. Rockefeller, Jr., Albert Shaw, Wallace Butterick and Starr J. Murphy, of New York; Edwin A. Alderman, president of the University of Virginia; Hollis B. Frissell, president of Hampton Institute; Henry Pratt Judson, president of the University of Chicago, and Wickliffe Rose, general agent of the Peabody Education Fund.

SCIENTIFIC NOTES AND NEWS

WITH a view of collecting material for the life of Alexander Agassiz, any one having any of his letters will confer a favor by sending them to his son, G. R. Agassiz, Museum of Comparative Zoology, Cambridge, Mass., U. S. A. The letters of any one who so wishes will be copied and the originals returned to the owner as soon as possible. If any persons are unwilling to part with the