and then he may feel how much more potent has been the lesson than all he has read in pages of abstract ratiocination.

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Prof. Alexander Graham Bell has presented a memoir to the National Academy on the formation of a deaf variety of the human race, in which he shows by tables a series of generations of certain families in which, the progenitors being deaf-mutes, this peculiarity becomes perpetuated in many of the descendants. Recognizing fully the laws of heredity, natural selection, etc., he shows that the establishment of deaf-mute schools, in which a visual language is taught which the pupils alone understand, tends to bring them into close association with each other; and that naturally, with this seclusion, acquaintance ripens into friendship and love, and that statistics show that there is now in process of being built up a deaf variety of man.

Dr. W. K. Brooks, animated by the cogency of Professor Bell's reasoning, is led to prepare an article entitled 'Can Man be Modified by Selection?' In this paper he discusses the startling proposition of Professor Bell, and recognizes the convincing proof which he furnishes to show that the law of selection does place within our reach a powerful influence for the improvement of our race. The striking character of the tables of facts presented by Professor Bell, and the significant suggestions of Dr. Brooks, lead one to consider how far the influence of selection has had to do with the character of great communities, as to their intelligence or ignorance. When we see nations of the same great race-stock, — one showing a high percentage of illiterates, a high death-rate, degradation and ignorance, while just across the borders another nation, apparently no better off so far as physical environments are concerned, with percentage of illiterates and death-rate low, intelligent and cleanly, — we are led to inquire if here a strict scientific scrutiny with careful historical investigation will not reveal the cause of these conditions. Can it be proved beyond question that the illiteracy and degradation of Italy and Spain, up to within recent years at least, is the result of centuries of Church oppression and the Inquisition, destroying at once, or driving out of the land, all independent thinkers, and at the same time forcing her priests to lead celibate lives, and inducing others of cultivated and gentle minds to lead cloister lives? Is it also a fact, as Alphonse de Candolle asserts, that by far the greater number of distinguished scientists have come from Protestant pastors? He gives a significant list of eminent men whose fathers were Protestant pastors, saying, that had they been priests of another religion, leading celibate lives, these men would not have been born.

It is considered an intrusion into matters which do not concern science when such inquiries are made, but the scientist has very deeply at heart the intellectual and moral welfare of the community. If the cause of degradation and ignorance, of poverty, of contagious disease, or of any of the miseries which make a nation wretched, can be pointed out by scientific methods, then it is the stern duty of science to step in and at least show the reasons, even if the remedy is not at once forthcoming. The men who would be reformers and agitators, and who by their earnestness and devotion get the attention of multitudes, are unfit for their work if they show their ignorance, as most of them do, of the doctrines of natural selection and derivation.

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In drawing to a close this very imperfect summary of what American zoölogists have accomplished for evolution, many other distinguished contributors might have been mentioned. The work of eminent physiologists and paleontologists has hardly been considered; nor has the long array of botanical facts for Darwin, as revealed in the fascinating study of the relations which exist between flowering plants and insects, contrivances for cross-fertilization, means of plant-dispersion, etc., and the distinguished botanists connected with this work, received attention here. Indeed, the proper limits for an address of this nature have been far exceeded.

Suffice it to say, that all these students have worked from the standpoint of derivative doctrines. A still greater triumph to Darwinism are the evidences of gradual conversion still going on among a few isolated workers who still remain stubborn, yet yielding to the pressure of these views by admitting features that ten years ago they repudiated.

There are two points to be emphasized here in closing: and one is, that American biological science stands as a unit for evolution; and the other is, the establishment of a great generalization which shows, that, when intelligence became a factor in animals, it was seized upon to the relative exclusion of other characteristics. This generalization offers an unassailable argument to-day for a wider, broader, and deeper education for the masses. The untold misery and suffering of the working-classes as witnessed in their struggles of the last two years would have been avoided had the rudiments of social science, even a knowledge of the value and significance of simple statistics, been appreciated by them.

The startling paper of Dr. Seaman (*Science*, viii. No. 190) on the social waste of a great city shows the blundering, criminal way in which municipalities are controlled by coteries ignorant alike of Science and the beneficent mission she stands waiting to enter upon.

PREHISTORIC CHRONOLOGY OF AMERICA.[1]

The prehistoric period of America dates back from the discovery of the several parts of the continent; and the problem is to reconstruct the history of the various nations who inhabited both Americas in this period. A review of the means at our command to accomplish this, divides them into six classes: —

I. *Legendary.* — This includes the legends or traditions of the native tribes. These often bear a strong resemblance to Semitic or other Oriental myths, but the similarity is a coincidence only, and those writers have been led astray who count it for more. The annals of the Mexicans, the Mayas of Yucatan, and the Quichuas of Peru, carry us scarcely five hundred years before the voyage of Columbus, although the contrary is often stated. The more savage tribes practically remembered nothing more remote than a couple of centuries.

II. *Monumental.* — The most famous monuments are the stone buildings of Mexico, Yucatan, and Peru. By many these are assigned an antiquity of thousands of years; but a calm weighing of the testimony places them all well within our era, and most of them within a few centuries of the discovery. The celebrated remains of Tiahuanuco in Peru are no exception. Much more ancient are some of the artificial shell-heaps along the coast. They contain bones and shells of extinct species, in intimate connection with stone implements and pottery. They furnish data to prove that the land was inhabited several thousand years ago.

III. *Industrial.* — The industrial activity of man in America may be traced by the remains of his weapons, ornaments, and tools made of stone, bone, and shell. In most of the deposits examined, specimens of polished stone and pottery testify to a reasonably developed skill; but in the Trenton gravels and a few other localities, genuine palæolithic remains have been found, putting man in America at a date coeval with the close of the glacial age, if not earlier. The vast antiquity of the American race is further proved by the extensive dissemination of maize and tobacco, — tropical plants of southern Mexico, which were cultivated from the latitude of Canada to that of Patagonia.

IV. *Linguistic.* — It is believed that there are about two hundred radically different languages in North and South America. Such a confusion of tongues could only have arisen in hundreds of centuries. The study of these languages, and of the gradual growth of their dialects, supplies valuable data for the ancient history of the continent.

V. *Physical.* — The American race is as distinctively a race by itself as is the African or white race. Although varying in many points, it has a marked fixedness of ethnic anatomy, and always has had. The oldest American crania, collected from the most ancient quaternary deposits, are thoroughly American in type.

VI. *Geologic.* — As the discovery of implements in glacial deposits locates man on this continent at least at the close of the glacial epoch, this carries his residence here to about thirty-five thousand years ago. But there is no likelihood that he came into being on this continent. He could not have developed from any of the known fossil mammalia which dwelt here. More probably some colonies first migrated along the preglacial land-bridge which

[1] Abstract of an address before the Section of Anthropology of the American Association for the Advancement of Science, at New York, Aug. 10–17, 1887, by Dr. Daniel G. Brinton, vice-president and chairman of the section.

once connected northern America with western Europe. Later, others came from Asia. At that time the physical geography of the northern hemisphere was widely different from the present.

These various data have as yet been but imperfectly studied: when they shall have received the attention they merit, we may confidently calculate on a large increase in our knowledge of the course of events in ancient America.

ECONOMY IN MANAGEMENT OF SOIL.[1]

IN this great metropolis, or wherever our association meets, we are shown with pride the abounding evidences of the progress of a great nation, and the material prosperity of its people.

Tracing this visible wealth to its source, we find that it has all, with insignificant exceptions, been produced from the soil. The American inheritance was a fertile soil. A policy perhaps warranted by the circumstances, but none the less improvident, has marked the growth of the nation. Generation after generation has recklessly drawn upon the stored fertility of the land, with no systematic effort at restitution, not only to supply the current support of people, but the surplus which has provided all our apparent wealth and private improvements.

The rapidly increasing demands of our own country are met, and more than met, so far as mere quantity is concerned, for a great surplus is annually sent abroad. For twenty years agricultural products have constituted three-fourths of the total exports from the United States, while in single recent years this proportion has reached eighty-three per cent, and amounted in value to nearly nine hundred million dollars. And it is manifest that this superabundance of soil-products will continue, despite any possible increase in population, at least well into the next century. We boast of our great exportation of soil-products, forgetting that this really means the sending to foreign lands great blocks of our store of natural fertility, thus disposing of the main source of our material wealth by the ton and by the million. The steady reduction in the fertility of the soil, which results from the annual draught by cropping and the absolute loss incident to ordinary disposition of the crops, is much greater than commonly understood, and a matter so important as to demand serious consideration.

For present purposes it is sufficient to refer to only three elements of plant-food, which are of vital importance, and in which the soil is most likely to be, or to become, deficient. A computation based upon the mean annual agricultural products of the United States at the present time, the average composition of these products as far as known to chemistry, and the cash value of the chief fertilizing-materials in domestic markets, gives the following stated quantities and values of the three elements named, which are taken from the land by the farming operations of every year: —

4,000,000	tons of	nitrogen,	worth $360 per ton.....	$1,440,000,000
3,000,000	,,	potash,	100 ,, ...	300,000,000
2,000,000	,,	phosphoric acid,	120 ,, ...	240,000,000
			Total value.....	$1,980,000,000

The effect upon the soil depends, of course, upon the disposition of the products embodying these enormous quantities and values. Fortunately, a very large part remain upon or are returned to the land, in the process of harvesting and preparing for market, and more in the form of water and residues incident to consumption.

On the other hand, there are vast absolute losses resulting from the well-known wastes of towns and cities, besides the portions actually sent to foreign countries. To exactly apportion the disposition made of these products, and hence of the fertilizing elements represented thereby, is impossible; but as to the latter, a rough approximation divides the total into three parts, respectively remaining on the land, returned to the soil, and wholly removed from it.

This country imports the agricultural products of other countries in considerable quantity, but in kind far less important to the question in hand than our exports.

The articles exported are largely of a character especially rich in plant-food. Making due allowances, therefore, I estimate the average exportations as representing thirteen per cent of the fertility value of our total products, and our absolute wastes at home at more than twenty per cent additional. Together these constitute a full third of the figures above given, or an annual removal from American soil, of nitrogen, potash, and phosphoric acid, worth, in the markets of this city to-day, more than six hundred million dollars. By our present system, or rather continued improvidence in the production of the necessaries of life, we are thus diminishing, at this alarming rate, the original capital of our foundation industry.

When products are exported, mainly food, which are worth seven hundred million dollars on our shores, there is included plant-food, all needed at home, which we cannot replace for one-third of that sum.

This fertility never comes back. It goes to enrich other lands, or is washed into seas from which we do not ever get the fish and the carp. Those of us who are contending with impoverished soils are well placed to appreciate the sober subject of agricultural exhaustion, and are in duty bound to send an earnest word of warning to those who labor on newer lands. The researches of modern times have done much in establishing truths of practical value regarding the effect upon the fertility of the land, of the removal of different crops and products, and hence teaching us what should be consumed at home, and what may be profitably sold.

Thus, if ton after ton of farm-produce be removed from a Western farm to an Eastern market, or from any American farm to a European market, it makes a great difference eventually, to the land where produced, and to its owner or user, whether these tons be cotton or corn, beef or butter.

The following table illustrates this point: —

Articles of Export.	Mean Annual Exports in Tons.	Approximate Value of 1 Ton at Place of Export.	Value of the Plant-Food in 1 Ton.	Percentage of Plant-Food Value on the Market-Value 1 Ton.
Cottonseed-meal...	250,000	$ 26.00	$28.04	108.00%
All 'oil-cake' and 'oil-meals'.....		24.00	23.80	100.00
Tobacco.....	150,000	200.00	15.92	8.00
Beeves alive.....	100,000	100.00	13.98	14.00
Dressed beef.....	50,000	160.00	13.99	8.75
Pork products.....	500,000	200.00	13.43	6.25
Wheat.....	3,000,000	(34 bus.) 34.00	8.80	26.00
Wheat-flour.....	750,000	(10 bbls.) 50.00	7.08	14.00
Corn (maize).....	14,000,000	(36 bus.) 23.00	6.94	30.00
Cotton.....	1,000,000	(4 bales) 200.00	.60	–
Butter.....	15,000	(40 tubs) 400.00	.52	0.13

It merely mitigates the evil presented, to note that the soil holds large quantities of plant-food still in store; that nature has provided supplies of mineral manures in concentrated form, deposited in various places; and that some investigators yet believe they will prove conclusively the assimilation by plants of the free nitrogen of the atmosphere.

Should this much-disputed question of nitrogen-supply be so settled, it would certainly remove a vast deal of anxiety, trouble, and expense; for, as we have seen, nitrogen constitutes three-fourths in value of the plant-food annually used by crops. But the prevalence of the belief that the growing plant depends almost exclusively upon the nitrates of the soil, and has no power to assimilate the free nitrogen of the air, is amply shown by the market-prices of ammoniated manures and the extent of their sale and use.

The trade in commercial fertilizers has reached wonderful proportions, and agriculturists hail with joy the discovery of every new deposit like the potash-salts of Germany and the mineral phosphates of Canada and the Carolinas. But the expense incident to mining, manipulation, and transportation, greatly impedes the use of these natural stores, and makes the more important every means of husbanding the home resources of every acre of valuable land. If the

[1] Abstract of an address before the Section of Economic Science and Statistics of the American Association for the Advancement of Science, at New York, Aug. 10–17, 1887, by Henry E. Alvord, C.E., of Amherst, Mass., vice-president of the section.