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AMERICAN CONTRIBUTIONS TO THE DEVELOPMENT THEORY.

The address which has deservedly attracted the greatest share of attention, out of the many learned essays delivered at the recent meeting of the American Association for the Advancement of Science, is Professor E. L. Morse's masterly summing up of all that America has done to promote the growth of the development theory. Professor Morse is an ardent evolutionist, a naturalist of great learning and ability, an indefatigable investigator, and, like most prominent men in the scientific world, has no hesitation in assuming the offensive in support of doctrines of the truth of which he is deeply convinced. Hence there is nothing resembling trimming in his discussion of the evolution question, the opponents of which receive scant mercy at his hands; but still very many of those whose scientific faith is thus attacked are among the Professor's warmest admirers, for he possesses the happy faculty of being always instructive, always original, and of lifting his topics out of the slough of technical pedantry in which too many of our learned scientists seem over inclined to bury modern acquisitions to our knowledge, especially of natural history.

Professor Morse tells us that the first clear premonition of the doctrine of natural selection came from an American, William Charles Wells, borne at Charleston, South Carolina, in 1757. In 1813 Wells read a paper before the Royal Society, in which he attempted to account for the color of dark-skinned races of men by citing the changes of animals under domestication, showing that varieties of men and animals were occurring, not exceptionally, but constantly, and that different breeds of animals were thus obtained by man's selective supervision. Hence he argued that a similar selection among men had been effected by the comparative immunity from certain diseases of those who had dark skins. This is substantially a part of the theory of natural selection now expanded by Darwin and credited wholly to him; but the verdure of originality, it seems, must now fade from the English naturalist's laurels. The honor belongs to an American inventor, who, like hundreds of his brethren since his day, has furnished the thoughts whence have sprung some of the most noted of foreign "discoveries." This is unquestionably the most important fact brought forward in Professor Morse's paper, and it will provoke universal comment.

Classifying the work of various American investigators, Professor Morse tells us that in producing new evidences for the doctrine of natural selection, Drs. Burt G. Wilder, Englemann, and W. K. Brooks and Professor Charles V. Riley have borne distinguished parts. Professor Riley's proof of the inter-dependence of flower and insect in the case of the yucca moth is a scientific triumph. The late Professor Jeffries Wyman completely ruined the beautiful theory that the cells of bees were of such construction as to use space and material to the best possible advantage. He found by close study that the cells of all cell-making insects are of all grades, from shapeless masses to those which approach but never reach perfection. The late Professor Chauncey Wright also did admirable work in showing that the arrangement of leaves of plants along their axis, was due to circumstances of growth, and was not a circumstance of blind law.

Professors S. F. Baird, J. A. Allen, and Robert Ridgway severally have found that marked differences in birds and mammals are due solely to their surroundings. Thus, for example, Western birds have longer tails than Eastern ones of the same species, and on the Pacific coast birds acquire a darker hue. Large numbers of like changes, when tabulated and shown on a geographical chart, were found coincident with variations already ascertained in the amount of rainfall in the different regions. The total number of species of birds was reduced about one fifth by these investigations, and the number of species of squirrels decreased one half or more.

As evidences of the transmutation of species, Mr. James Lewis has discovered that a truncate form of mussel, which, by the loss of one of its segments, had been distinguished from another form, takes its peculiar shade from the circumstances to which it had been exposed, namely, the abrasion of its edges and consequent retarding of its growth in the rapid currents of the Mohawk River. Mr. A. G. Wetherby has called attention to changes in snails under like conditions; and Dr. Cooper and Messrs. Stearns, Bland, and Birney, have all described instances in which changes in animals have followed altered circumstances of heat or moisture. Among the examples of the survival of forms by adaptation to changed environment, the discovery by Mr. Ernest Ingersoll of marine mollusks and living salt water crabs, high up on the Rocky Mountains, is the most remarkable. Professor Marsh has made a series of brilliant researches concerning the siredon, an animal of the salamander kind, that loses its gills, and becomes, when removed from its natural habitat, one previously recorded under an entirely different genius (*amblystoma*). The researches of Drs. Packard and Putnam have overthrown Agassiz' theory that the blind fish of the Mammoth Cave are of a race created in their present condition by showing that a whole series of fishes, ranging from those with perfect eyes to those without any, including between them various deficiencies of vision, have been found in American caves and secluded waters. The discoveries of Professors Leidy, Marsh, and Cope, among the tertiary mammals of the West, have filled wide gaps between older and existing forms, showing all the intermediate animals, so that we have nearly the whole ancestry of the horse, back to the five-toed animal, not larger than a fox, in the eocene period.

The remainder of Professor Morse's admirable address sets forth the present theories of Darwin and the evolution school, and more especially dwells upon the gradual development of the intellect of animals. The earliest mammals had the smallest brains; and as we go upward in the strata, the size of the brain gradually increases. Its development in the monkey tribe was regarded as the means by which these animals were enabled to escape from the carnivora which formerly abounded; and intellect even in that early era thus proved its superiority to brute force.

In his conclusion, Professor Morse showed how perfectly the evolution doctrine accounts for the fatalism of the Turks, the cruelties of savages, and the outrages generally among civilized people, attributed to the total depravity of humanity. He considers all such manifestations as simply relapses to the savage nature which we all inherit from animal progenitors; and that where such relapses in any individual become constant, it is the duty of society to treat that individual practically as it would a dangerous beast, and so govern him as to prevent his propagating his kind.

THE COMING EXPLOSION AT HELL GATE.

General Newton has recently stated that the great explosion at Hell Gate will take place during the latter part of September. The excavations have been complete for some time past, but delays in passing the appropriation bill by Congress checked further operations, and for this reason the blow-up did not occur on the 4th of July, as for a long period was contemplated. Those who expect to witness a gigantic column hurled hundreds of feet into the air, or look forward with some trepidation to the effects of fearful concussion on adjacent buildings, will hardly find their anticipations realized. The mine will be flooded previous to the explosion; and with the possible exception of jets forced through seams in the rocks, there is no reason to believe that any very remarkable exhibition of the tremendous force of the explosives will be manifest. From a scientific point of view the occasion will be of considerable interest, as the earth in the vicinity will be shaken by the communicated vibrations, which are likely to travel over a long distance. An opportunity will thus be afforded for measuring the velocity of sound waves through earth, and preparations are being made by scientific men to observe the same at points at distances 200 and 300 miles away.

The arrangements to guard against any possible danger are being perfected, in utter disregard of the desires both of those who hope to see the great blast, and those who aspire to profit pecuniarily through the popular curiosity. Steamboats and other craft will be warned away, so that a view from the river will be out of the question; the authorities have been requested not to grant passes to would-be spectators on Ward's Island, the best point of observation; and a bluff of earth and the buildings near the works prevent seeing the operations from the rear, so that the expectant populace will probably have to satisfy themselves with a distant view from the high land on the New York shore.

How much powder, etc., will be burnt is not yet definitely stated. An approximate idea of the quantity may be gathered from the fact that there are about 4,000 drill holes, each 3 inches in diameter, and varying from 7 to 13 feet in depth. Each will be charged with a separate canister of dynamite, vulcan, and rend-rock powder, and the simultaneous explosion will be effected by the current from a battery of 800 cells. About two pounds of powder are used to one of dynamite, and the charges are inserted in the 172 piers of rock and in the roof supported thereby. It is estimated that 30,000 cubic feet of broken rock will be left under water, and this will have to be removed by dredging so as to secure a channel 26 feet in depth. The total length of tunnels, galleries, etc., excavated, is 7,425·67 feet. The amount thus far expended is $1,686,841.45.

CHEAP COAL.

The breaking up of the coal combination and the consequent throwing upon the market of half a million tuns of coal is a welcome event. The whole coal trade of the East has, for several years, been under the absolute control of a monopoly which has signalized its sway by unwaveringly maintaining high prices, without regard to the demand first, or the depressed condition of all business affairs. It is characteristic of the patience of our people that no means have been tried to mitigate this condition of things; but now that the crisis has come, it is like a gleam of sunlight through the black shadows which have fallen across the prosperity of the industrial world. When coal is once more subject to the natural laws of trade, and not until then, will its traffic rest on a sound basis; and when this comes to pass, then we may look for a revival in iron manufacture, and in all the industries in which steam is used. Too many people are undergoing the effects of long existing business stagnation not to watch eagerly for any sign, however faint, indicative of better times, and therefore the gratification felt and openly expressed, at the collapse of the combination, is undeniably great. One public sale of 500,000 tuns will not affect the whole winter's trade, however, any more than one cold day represents the whole winter's weather; but as matters now appear, the present event is only a beginning, and predictions are freely hazarded that we shall see still lower prices.

The fall in rates at the late auction seem to have astonished every one, and none more than the coal dealers themselves. The reduction from the combination schedule for August averages about $2.10 per tun, and average prices ranged from $2.20 for Philadelphia & Reading chesnut to $3.86 5/10 Delaware & Hudson stove. The Vice-President of the Pennsylvania Coal Company asserts that it would cost $500,000 more to mine the coal than the prices fetched at

the sale amount to. The agent of the Delaware & Hudson Canal Company counts up the various expenses of handling, mining, commissions, etc., and claims that a tun of coal costs at tide water $4.15, while the average at the sale was but $2.42. In the coal regions, the operators say that either tolls and labor must be greatly reduced or they must suspend operations. Miners' strikes are feared, and altogether the prospects are gloomy for both laborers and owners.

THE SCIENCE OF MECHANICAL MOVEMENTS.

There are numerous treatises devoted to descriptions of great inventions and discoveries, and discussions of the processes of reasoning by which they were worked out. It has long, too, been recognized that there is such a thing as scientific invention, in which the mechanic, having definitely determined the result which he wishes to attain, proceeds to achieve it by a series of systematic steps. It is true that the genius for making discoveries, with which some men are endowed, gives them a great advantage over their fellows; but it is equally true that genius, properly directed, is far more certain of success than if it acts without a guide. This is sufficient to account for the great interest which has been taken in the matter by professional writers, and the number of treatises relating to it that have been published. Few of these works, however, go farther than to show the nature of inventions that have already been perfected, and to give discussions of the motions that are produced. It is a great advance when a writer offers to the public a method which is capable, not only of analyzing all existing mechanical movements, but also of furnishing the outlines of any movement that may be desired. This is the claim made by Professor Reuleaux in his "*Theoretische Kinematik*," a work which has excited great interest in Germany, and has recently been translated into English. Professor Reuleaux' method of analysis possesses the merit of great novelty, and a description of its nature may be received with favor by readers of an inventive turn of mind.

The reader who is familiar with analysis knows that the discussion of an equation is a very thorough method of determining all the conditions and variations of a given question. The well known problem of the lights, which is to be found in most elementary treatises in algebra, is a good example of this kind; and still better illustrations will occur to the reader in the discussions of some of the equations deduced in what is commonly known as analytical, but more correctly as general, geometry. A somewhat similar plan is adopted by Professor Reuleaux in his *Kinematik*. All ideas of force and time are disregarded in the consideration of a mechanism, and he merely concerns himself with the motions that are produced. The geometrical methods of determining changes of position are explained; and the nature of simple mechanisms and the manner of compounding them are fully illustrated. This part of the work may be compared with the introduction to the study of algebra, in which the idea of generalization is first presented to the student. Then the notation by which mechanisms are to be represented is introduced. The system adopted, which is entirely novel, cannot be properly explained in a limited space, but some of its characteristics may be noted. The different elements of a machine, such as screws, prisms, cylinders, cones, etc., are indicated by appropriate letters, accented in such a manner as to show whether they are hollow or solid. Letters connected by a dotted line indicate that the two elements are joined by a link, a comma shows connection by contact, an underscoring of a dotted line stands for a fixed link, an elastic link or spring is marked by a wavy line over the dotted one, etc. The notation is by no means complex, and can be mastered in a short time by any one who is accustomed to the use of algebraic symbols. It will be a surprise to many to find that the elementary parts of mechanism are comparatively so few in number. The use of the notation having been illustrated by numerous examples, properly graded, the author proceeds to the final analysis of mechanisms, or discussion of the expressions given by the notation. This is, of course, the object of the whole work, to which all that has preceded has been only preparatory. The reader who has followed the description so far cannot fail to see that the method seems to show the possibility of a thorough analysis of any mechanism that can be included in the notation. Those who feel an interest in rotary engines (and few engineers have not designed at least one of these machines) will find that this class of machines has been pretty thoroughly analyzed by Professor Reuleaux. The work is by no means exhaustive in every field of mechanical movements, but is rather intended to furnish the investigator an instrument which he can use in his own explorations. Even those who do not care to study the work thoroughly can scarcely fail to gain some useful ideas from turning over the pages and inspecting the sketches of the various movements shown.

SOME NEW LIGHT ON THE ORIGIN OF THE TRUFFLE.

The truffle is a species of underground fungus largely used in French cookery to give a peculiar rich flavor to meats. It comes principally from France, where it is always found in oak or beech woods, and can only be gathered through the agency of the keen scent of dogs or pigs especially trained to hunt for it. Both from the difficulty of obtaining the fungus, and from the fact that it is a delicacy highly prized by epicures, it brings in all markets a large price; and thus truffle hunting has long been a remunerative calling for the French and Italian peasantry. In appearance, the truffle is a blackish mass, covered with protuberances and weighing from an ounce to several pounds; when cut open it presents a marbled appearance, and its reproductive portion (it is sexless) is found in the veins in the shape of minute sacs which never open, each containing several spores, possessing spine-covered or honeycombed surfaces.

Numerous attempts have been made to cultivate these fungi, but with little or no success. Regarding their early development, comparatively nothing has been known, and the spawn or vegetative portion, which, in the case of the mushroom, is readily obtained, allowing the cultivation of that fungus to any degree, has not yet been definitely found in the truffle. Sprinkling the earth with water, in which the parings of truffles have been steeped, has resulted, it is stated, in producing them; and they have likewise been obtained by the slow process of planting calcareous soil with acorns and waiting for the saplings to reach a few years' growth, when the truffles could be gathered among the roots. Still no practical method of cultivating the truffle is in existence; and since they are found completely isolated from anything which could produce them, we are left in the dark as to how they are originated, or at best with merely the supposition that, at an early period of their development, they are parasites of the tree roots, or the theory that, like oak galls, they are due to the stings of insects. This last conjecture, however, arising from the fact that truffles are attacked by dipterous insects, like other nitrogenous cryptogams, has been refuted by the entomologists.

A very curious and recent experiment by M. Brefeld throws some new light on the subject, and may lead to the long sought method of cultivation. The *penicillium glaucum* is the well known green mold which appears on bread and cheese, and which owes its name to the fact that, in free air, it consists of chaplets of spores, in brush form, connected to a stem or pedicle. The mode of reproduction of this mold depends on the medium in which it exists. Now, by placing the *penicillium* in a closed vessel with very little air, M. Brefeld has obtained nodules which, after being buried in moist sand, fructify with internal *asci* which do not open. That is to say, they are produced in a manner analogous to truffles. The *asci*, we may explain here, are the little sacs in which the spores are contained, and are found in many complex forms of fungi, which build up a special organ called the *peridium* to hold these sacs.

It will be seen from M. Brefeld's discovery that he has noted two forms of green mold, one aerial, or *penicillium*, the other existing when partially deprived of air, or tuberaceous. The truffle through its subterranean location is always in confined air, present besides in limited quantities, and in that state is sexless. Now it remains to find its aerial form, to discover the peculiar *penicillium*, which placed under the conditions noted will produce, for its nodule, a truffle.

IS BROTHER JONATHAN SO VERY SLIM?

In our examination of the newly published medical statistics of the Provost Marshal General's Bureau of the late war, with regard to the relative hight of American men, we had the pleasure of showing, the other day, that the native born among our citizens and soldiers stood first in point of stature; while in every instance the foreign born exceeded the stature accorded them in the statistics of the nations they represented. We not only raise the tallest men, but draw from foreign countries, by emigration, men of more than average stature.

The artists are therefore quite right in always depicting the typical American, Brother Jonathan, as very tall. But they also make him very slim; and theorizing travelers have never hesitated to give a reason for his being long-legged and lank. One blames the climate; another, tobacco; another, bad cookery; another, his excessive "push" and eagerness in business; while the extra scientific Buchner was sure that the continent was altogether unfavorable to the European type of man, and would allow us no alternative but extermination or a speedy approximation to the Indian type. But is the average American really so slab-sided and lean?

Let us see what answer our statistics give. How do we compare with other nations in girth and weight? As statistics of mean weight have but little value apart from measurements of hight and girth, and age, we will first examine the records with regard to the degree of maturity of the several racial elements of our armies.

From the statistics gathered by the Sanitary Commission, Gould found the mean age of 1,012,273 men of all nativities, mostly volunteers, to be 25 years and 10 months. As a careful analysis of statistics of physical development shows that American born white men do not attain their full growth until between thirty and thirty-five years of age, it is obvious that the results obtained from these statistics will under rather than over rate the average dimensions of American men. It will be seen, too, from the following table of men enlisted toward the close of the war, when the average age of recruits was highest, that, with the exception of a small number of Canadian recruits, the native born element of the army was the youngest.

Nativity.	Number.	Mean Age.
United States.....	196,980	26·955 years.
British Possessions...	14,954	25·352 "
England.....	10,103	27·855 "
Ireland.....	30,412	27·216 "
Germany.....	30,943	31·029 "

Unfortunately the instructions to enrolling surgeons did not direct them to record the weight of the men examined. Only the more energetic officers took the trouble to make their work complete in this respect; consequently the statistics on this point are less full than could have been desired. Still an idea of the relative bulk of the men of the five principal nativities may be had from the following tables, showing the relation of hight, girth of chest, an expansion of chest to increasing weight in over 10,000 men of all ages from 18 to 45 years. The men, when weighed and measured, were invariably naked.

WHITE NATIVES OF THE UNITED STATES.

Weight.	Number of men.	Mean hight. inches.	Mean girth of chest at expiration.	Mean expansion of chest.
Under 100 pounds.....	14	64·000	29·714	3·071
100 and under 120.....	991	65·191	30·468	3·146
120 and under 140.....	2,968	66·856	31·997	3·238
140 and under 160.....	1,894	68·424	33·642	3·289
169 and under 180.....	427	69·920	34·988	3·289
180 and over.....	65	70·215	36·554	3·269
Total and mean of total.	6,359	67·297	32·491	3·242

BRITISH AMERICANS.

Under 100 pounds.....	2	64·000	30·000	3·500
100 and under 120.....	38	64·211	30·737	3·184
120 and under 140.....	304	66·546	32·020	3·247
140 and under 160.....	198	67·848	33·606	3·298
160 and under 180.....	41	69·512	34·439	3·402
180 and over.....	6	69·333	35·333	3·333
Total and mean of total.	589	67·059	32·666	3·272

ENGLISHMEN.

Under 100 pounds.....	0	——	——	——
100 and under 120.....	56	64·067	30·893	3·107
120 and under 140.....	243	65·835	32·453	3·154
140 and under 150.....	128	67·625	33·609	3·242
160 and under 180.....	25	68·480	34·960	3·380
180 and over.....	2	69·000	38·000	3·500
Total and mean of total.	454	66·348	32·749	3·187

IRISHMEN.

Under 100 pounds.....	3	62·667	30·667	2·167
100 and under 120.....	158	64·532	31·519	3·215
120 and under 140.....	724	66·119	32·715	3·181
140 and under 160.....	450	67·609	33·916	3·233
160 and under 180.....	74	69·270	35·357	3·338
180 and over.....	8	69·000	36·750	3·250
Total and mean of total.	1,417	66·589	33·119	3·208

GERMANS.

Under 100 pounds.....	3	63·333	30·000	2·833
100 and under 120.....	168	64·167	31·357	3·262
120 and under 140.....	675	65·532	32·601	3·226
140 and under 160.....	389	66·905	33·969	3·231
160 and under 180.....	104	68·346	35·192	3·221
180 and over.....	4	69·000	36·000	3·500
Total and mean of total.	1,343	65·985	33·047	3·231

Taking into account the relative youth of the American element of our armies, and the probable inferior age of the Americans furnishing the foregoing measurements, their slight inferiority in girth of chest is not at all remarkable. It certainly does not indicate any excessive lankness in the natives of this country.

Dr. Baxter has compiled a table exhibiting the mean results of a great number of sets of observations by various authorities. Most of them are too fragmentary to be of use in this enquiry; but such as are complete as regards age, hight, girth, and weight, we have brought together in the following table: Though not sufficiently complete to warrant any sweeping generalization in regard to Brother Jonathan's physical qualities, it carries evidence enough at least to satisfy one that the typical American is a fair specimen of humanity, in bulk and weight, as well as in stature.

Nativity.	Mean age. Years.	Mean hight. Inches.	Mean cir. chest. Inch	Mean weight. Pounds.	Authority, etc.
United States	24·01	67·36	——	148·29	Coolidge: 1,537 recruits.
	23·94	67·05	34·99	147·50	Elliott: 1,700 army of Potomac.
	25·62	67·34	34·43	144·83	Gould: 8,349 volunteers.
	——	67·22	35·69	142·80	" " 12,757 "
	26·39	67·30	32·49	136·05	P. M. G.'s Bureau: 6,359 recruits.
British America	24·94	67·06	32·67	138·69	" " 589 "
England	24·31	——	——	148·41	Coolidge: 3,439 U. S. soldiers.
	24·00	65·94	——	138·46	Dawson: 1,500 civilians.
	27·36	66·35	32·75	135·64	P. M. G.'s B.: 454 recruits.
Scotland	28 to 45	67·72	——	148·69	Beddoe: 1,982 civilians and soldiers.
	25·00	68·80	——	144·03	Forbes: students.
	18 to 45	67·07	33·84	——	P. M. G.'s B.: 3,476 recruits.
Ireland	26·80	66·59	33·12	136·46	" " 1,417 "
	23 to 45	——	——	137·98	Beddoe: 1,616, nearly all soldiers.
France	30·50	64·84	34·61	143·20	Bernard: 400 infantry of guard.
	30·—	66·10	35·43	141·10	Allaire: 780 cavalry "
Germany	30·10	65·98	33·05	136·48	P. M. G.'s B.: 1,343 recruits.

It will be seen that the average American compares very favorably with the best specimens of the race, the English and the Scotch, as regards bulk and weight. The most extensive series of observations on this head ever made in Great Britain are those of Dr. Beddoe, who collected measurements of over 17,000 civilians and soldiers, between twenty-three and fifty years of age. From these he calculates the mean hight of Englishmen to be 5 feet $6\frac{6}{10}$ inches, and that of Scotchmen 5 feet 7½ inches. From the careful measurement of one half a million men, little and big, sick and well, by the Provost Marshal General's medical staff, it appears that the average hight of the men of eight of our Northern States exceeds 5 feet 8 inches. In sixteen States, the average exceeds that of the Scotch; and in one State only (Connecticut) does it fall so low as that of the average Englishman.

In the matter of bulk, the comparison, as we have seen, is not less favorable to Brother Jonathan. He is as heavy as the heaviest even in his youth: and the apparent slimness of his immaturity, due to his superior hight, is fairly made up for by the time he reaches his full development.

ARTIFICIAL TEETH.—Mr. Merrick Bemis, of New Haven, Conn., desires us to state, that his patent (which we quoted on page 106, volume XXXV, and which states that the plates are intended to fit over natural teeth, and in which the teeth are described as all molars) covers the application of the invention to all teeth.