and as an exception a mild form of the disease—the frequency of the exception depending, it seems, to a great extent upon the prevailing character of the plague, while an inoculation with the cultivated Schizophytes is, as a rule, followed by a mild attack, and as an exception, or in rare cases only, by Swine-plague in its severest form.

Wherever Swine-plague is prevailing in its most malignant or fatal form, or, what is essentially the same, wherever formation of ulcerous tumors in the cæcum and colon is a frequent occurrence, where consequently an abundance of Swine-plague Schizophytes is discharged with the excrements of the diseased animals, there the spreading from animal to animal, and from herd to herd, is a rapid one; and *vice versa*, wherever the spreading is rapid, there ulcerous tumors in the intestines are a frequent occurrence. In 1878 the same (the ulcerous tumors) could be found in about 75 per cent. of all cases that had a fatal termination, while at present (in Illinois) their occurrence is probably limited to about 5 per cent. of all cases.

THE KANSAS CITY ELECTRIC TIME BALL.

By Prof. H. S. PRITCHETT, Astronomer at Morrison Observatory, Glasgow, Missouri.

The first time ball established in the United States was dropped from the dome of the Naval Observatory at Washington in 1855. It is still dropped at Washington mean noon, and has for a long time furnished the standard time for the city and the Departments of the Government.

The New York time ball, established in 1877, is dropped at New York noon, by an electric signal, sent from the Naval Observatory at Washington. It was erected and is maintained by the Western Union Telegraph Company, and is dropped from their building on Broadway. At 11h. 55m. the ball is hoisted half-way up the staff on the tower of the building. At 11h. 58m. it is hoisted to its highest point, when it is about 250 feet above the street and can be well seen by the shipping at the New York and Brooklyn docks, and vessels in the bay, and from suitable positions is visible to a large part of the citizens of New York, Brooklyn, Hoboken and Jersey City.

If on account of wind the ball fails to drop at 12h. om. os., it is held till 12h. 5m. and then dropped. In such cases a small red flag is hoisted at 12h. 1m. and kept flying till 12h. 10m. This ball was for some time dropped by hand, but for the last year the dropping has been automatically effected by the clock at the Observatory. The working of the apparatus has been in the main satisfactory, and the ball has been dropped quite regularly, the failures being caused almost entirely by temporary breaks in the wire or other causes which could not be foreseen.

In the evening papers of the day and in the papers of the next morning a notice is regularly inserted, stating whether the ball dropped at correct time, and if not, its error, fast or slow. Many are at a loss to know how this correction is obtained. It is arrived at in the following manner: The time of the falling of the ball records itself automatically by electricity, near the standard clock of the Western Union Company in the building, the clock itself being regulated by the daily clock-signals from Washington. The difference between the time of falling of the ball and noon, as indicated by the clock, is thus obtained by a direct comparison. This assumes of course the accuracy of the clock, and during a long continued season of cloudy weather, or in case of accident to the clock itself, the time might be somewhat in error, although the published correction might show but a few hundreths of a second. At present however, the Western Union has the benefit also of the Alleghany and Cambridge signals, for the regulation of this clock, so that even during the longest season of cloudy weather it is not probable that the clock could be much in error.

The Boston time ball, which is dropped at noon of Boston time, by means of the noon-time signal from the standard clock of the Harvard College Observatory, is placed upon the large building of the Equitable Life Assurance Company and was paid for and is now maintained by this company. The ball is of copper and weighs about 250 pounds. The machinery used in raising and controlling it is hence much more complicated and costly than in either of the cases before mentioned. The cost of ball and machinery was about $1200. The electric signal which drops it, is given by the clock itself, the ball having a drop of fifteen feet. The nearness of the Observatory, and the fact that the wire used is wholly under its control, give additional convenience and certainty in the dropping of the ball, and reduces the probability of accidents to a minimum, so that it is effected with great regularity and precision. Prof. Pickering, Director of the Observatory, reports for the year ending Nov. 1st, 1880, the ball was dropped exactly at noon on 355 days; on four other days at five minutes past noon, in accordance with the rule adopted; on four other days it was not dropped, leaving only three cases of inaccuracy of dropping.

Quite recently a time ball has been established at Hartford, Conn., and dropped by the Winchester Observatory of Yale College.

The time ball recently erected at Kansas City, and which is dropped as a part of the time service of the Morrison Observatory, is the first attempt in this direction in the West. It was paid for chiefly by an appropriation of the City Council of that city. The site selected was the large building just erected by the Messrs. Bullene, Moores & Emery, on Delaware street. The ball when raised to the top of the staff is about 140 feet above the street, and is generally visible to the business portion of the city. The ball which passes over the staff, is simply a wire skeleton covered with canvas and painted black, and is about three feet in diameter. It was loaded on the inside with lead until it was found to drop instantly and without loss of time. It has a drop of about twenty-five feet and is slowed up as it reaches the bottom, and is received upon a set of tall springs surmounted by a stout cushion.

The apparatus by means of which the ball is dropped at precisely the right instant, was constructed under the direction of Mr. W. F. Gardner, the instrument maker of the Naval Observatory at Washington, It is of a very simple form, and is found to answer all requirements.

This has been found to work easily and without loss of time and can scarcely get out of order. The entire cost of mounting the ball and machinery was only about $120, and with this small amount it was necessary to use the utmost economy in the purchase of materials and apparatus. Kansas City is about one hundred miles from the Observatory, and except in cases of breaking of the wire, when the ball cannot be dropped at all, it is dropped within one or two-tenths of a second of correct time.

The discrepancy in the local time kept by different jewelers in the city before the erection of the ball was astonishing, and led to endless confusion in business and travel.

On the first day the ball dropped, this difference, in extreme cases, amounted to fifteen or twenty minutes, some being eight or ten minutes fast, others as slow. The establishment of the time ball has brought about a uniformity never before known, and must soon make itself felt, not only as a convenience, but a promoter of punctuality in business engagements.

From the daily clock-signals sent over the wires from the Observatory it will be easy to establish a similar time signal in any city in the West, which will take the

necessary steps to procure these signals. An arrangement has been made also by which they may be distributed to jewelers and clockmakers, and manufacturing establishments in the larger cities.

THE UNITY OF NATURE.

By the Duke of Argyll.

VII.

ON THE MORAL CHARACTER OF MAN CONSIDERED IN THE LIGHT OF THE UNITY OF NATURE.

(*Continued*).

Of one thing, at least, we may be tolerably certain respecting the causes which have led to this extreme dispersion of Mankind to inhospitable regions, at a vast distance from any possible center of their birth. The first Fuegian was not impelled to Cape Horn by the same motives which impelled Mr. Darwin to visit that country in the *Beagle*. The first Eskimo, who wintered on the shores of Baffin's Bay, was not induced to do so for the same reasons which led to the expeditions of Back, of Franklin, or of Rae. The first inhabitants of Australasia did not voyage there under conditions similar to those which attended the voyages of Tasman or of Cook. We cannot suppose that those distant shores were first colonized by men possessed with the genius, and far advanced in the triumphs, of modern civilization. Still less can we suppose that they went there under the influence of that last development of Man's intellectual nature, which leads him to endure almost any suffering in the cause of purely scientific investigation.

Nor is this the only solution of the difficulty which seems to be absolutely excluded by the circumstances of the case. Within the historical period, and in the dim centuries which lie immediately beyond it, we know that many lands have been occupied by conquering races coming from a distance. Sometimes they came to subdue tribes which had long preceded them in occupation, but which were ruder, as well as weaker, than themselves. Sometimes, as in the case of the northern nations bursting in upon the Roman empire, they came to overthrow a civilization which had once been, and in many ways still was, much higher than their own, but which the progress of development in a wrong direction had sunk in degradation and decay. Sometimes they came simply to colonize new lands, at least as favored, and generally much more favored, than their own—bringing with them all the resources of which they were possessed—their flocks and herds, their women and children, as well as their warriors with chariots and horses. Such was the case with some of those nations which at various times have held their sway from Central Asia into Eastern and Central Europe. They were nations on the march. But no movement of a like kind has taken place for many centuries. Lastly, we have the emigrations of our own day, when civilized men, carrying with them all the knowledge, all the requirements, and all the materials of an advanced civilization, have landed in countries which by means of these could be made fit for settlement, and could be converted into the seats of agriculture and of commerce.

Not one of these cases can reasonably be supposed to have been the case of the first arrival of Man in Australasia. The natural disadvantages of the country, as compared with the richness and abundance of the regions from which he must have come, or which were on his southward line of march, preclude the supposition that men were attracted to it by natural objects of desire. We know by experience that if the first settlers had been in a condition to bring with them the higher animals which abound in Asia, these animals would have flourished in Australia as they now do. And so, also, with reference to the cereals—if these had ever been introduced, the modern Australians would not have been wholly without them, and would not have been compelled to live so much on the lowest kinds of animal and vegetable food—on fish, lizards, grubs, snakes, and the roots of ferns.

There is, however, one answer to Mr. Darwin's question, which satisfies all the conditions of the case. There is one explanation, and only one, of the dispersion of the human race to the uttermost extremities of the habitable globe. The secret lies in that great law which Malthus was the first to observe and to establish—the law, namely, that population is always pressing on the limits of subsistence. There is a constant tendency to multiplication beyond those limits. And, among the many consequences of this tendency, the necessity of dispersion stands first and foremost. It is true, indeed, that under some conditions, such as those which have been already indicated, the most energetic races, or the most energetic individuals, have been those who moved. But under many other conditions the advantage has been in favor of those who staid. Quarrels and wars between tribe and tribe, induced by the mere increase of numbers, and by consequent pressure upon the means of living, have been always, ever since Man existed, driving the weaker individuals and the weaker families farther and farther from the original settlements of Mankind.

Then one great argument remains. In the nature of things the original settlements of Man must of necessity have been the most highly favored in the conditions he requires. If, on the commonly received theory of Development, those conditions produced him, they must have reached at the time when, and in the place where, he arose, the very highest degree of perfect adaptation. He must have been happy in the circumstances in which he found himself placed, and presumably he must have been contented to remain there. Equally on the theory of Man being a special creation, we must suppose that when weakest and most ignorant he must have been placed in what was to him a garden—that is to say, in some region where the fruits of the earth were abundant and easily accessible. Whether this region were wide or narrow, he would not naturally leave it except from necessity. On every possible supposition, therefore, as to the origin of Man, those who in the dispersion of the race were first subjected to hard and unfavorable conditions would naturally be those who had least strength to meet them, and upon whom they would have accordingly the most depressing effect. This is a process of Natural Rejection which is the inseparable correlative of the process of Natural Selection. It tends to development in a wrong direction by the combined action of two different circumstances which are inherent in the nature of the case. First, it must be always the weaker men who are driven out from comfortable homes; and, secondly, it must be always to comparativly unfavorable regions that they are compelled to fly. Under the operation of causes so combined as these, it would be strange, indeed, if the physical and mental condition of the tribes which have been exposed to them should remain unchanged. It is true, indeed, that adverse conditions, if they be not too severe, may develop energy, and result in the establishment of races of special hardihood. And in many cases this has been the actual result. But, on the other hand, if physical conditions be as insuperable as those which prevail in Tierra del Fuego or in Baffin's Bay; or if, though less severe than these, they are nevertheless too hard to be overcome by the resources at the disposal of the men who are driven to encounter them, then the battle of life becomes a losing one. Under such circumstances, degration is unavoidable. As surely as the progress of Man is the result of opportunity, that is to say, as surely as it is due to the working of his faculties under stimulating and favoring conditions, so surely must he descend in the scale of intelligence and culture, when that opportunity is taken from him, and when these faculties are placed under conditions where they have no call to work.

It is, then, easy to see some at least of the external circumstances, which, first, in the natural course of things,