

sealed flask, or preserved them from destruction in the preparation of it, than to conceive it possible that life, if really capable of producing itself spontaneously, should have remained inert under any circumstances. To continue, Mr. DENTON traces the similarity in early forms of being, and points to the close resemblance of the *embryos* of man and the animals to support the theory of evolution. Evolution admitted, the question remains, then, of cause, and it is here that his theory branches from the doctrines generally propounded. Mr. DENTON sets aside natural selection, and for the most part sexual selection, as inadequate, in his opinion, to account for the changes. After tracing with painstaking care the various operations of variation, tendency, modification, hereditary transmission and natural selection in a modified form, he proceeds to account for their systematic action in the production of man. Man's origin is undoubtedly natural in the sense of owing its development to the operation of natural laws, but it is also—and here is, we take it, the new point of Mr. DENTON'S theory—spiritual. The operation of building up from the first beginnings of life the most perfect expression of it which we have on earth, has been presided over by a Nature which has, we submit, all the characteristics of a God, and which may be readily exchanged for Him, by those of us as are not yet ready to give up our old-world associations.

This theory, it seems needless to say, involves the future life of the soul.

“Why should millions of ages have been spent to produce a being to whom future existence is so desirable, and then deny him what he of all the world only craves? There is a life after death; the past teaches it, the present declares it.”

Nature then, during the millions of years she has required to produce the present generation, has been striving after perfection. The result of those struggles is man as we find him to-day. The future is to bring infinite happiness not only to the race, but to each member of it.

“And what (Nature) has done for the race is an indication of what she will do for the individual.”

Here, then, is the theory in a nutshell; and here, we conceive, the grand objection. Follow the argument to its legitimate conclusion. Putting aside the question, which naturally arises, of where the line of the future existence is to be drawn between man and his ancestors (for why the first man should be worthy of Heaven and his immediate progenitor, the last ape, and his existence on earth is not at all clear, nor does Mr. DENTON seem to insist upon it) granting that it is only men who are to have a future, we may ask, Are all men of all ages included in this grand promise? Are the gentlemen who dined off Captain Cook equally deserving of the exertions of Nature on their behalf with Mr. Disraeli or Cardinal Newman? There can be but one answer. They are alike men, they must alike be admitted to immortality. Well, then, Mr. DENTON, is it not all a failure? Here has Nature been for millions of years struggling after perfection. She has partially attained her aim in the nineteenth century, will, no doubt, attain to it more perfectly in the odd millions of years left her for her operations on this planet; and then this done, will she not have to begin all over again with Heaven? It has taken millions of years to fashion out of the primeval man a Huxley or a Lyell. And lo! this life ended, and the primeval man is back again in his original simplicity (for remember the future is for individuals), and it may

be expected that Mr. Lyell will have to complete the course of instruction which Nature has failed to bestow.

Such is, we take it, the objection to the new system. That such an objection does not hold to the Christian doctrines of a future life, might be shown readily, though our space is too limited for present discussion of the subject. Meanwhile, in the general acceptance of the doctrine of a future life amongst our leading scientists is reason for congratulation amongst those of us who recognize in science the handmaid and not the mistress of revealed-religion.

Chemistry, Physics, Technology.

CHEMISTRY AND PRODUCTION OF GUN COTTON AND NITRO-GLYCERINE.

BY E. M. EISSLER.

All the organic nitro compounds bear in their production from certain organic bodies the same characters—namely, all these nitro combinations are produced from the original body by the exchange of a certain number of equivalents of hydrogen against an equal number of hyponitric acid. For instance:

Cellulose (cotton) $C^{12} H^{10} O^{10}$ or $C^{30} H_7 O^{10} H_3$ changes into nitro-cellulose or gun cotton, $C^{12} H_7 O^{10} (NO_4)_3$ or $G^{12} H_7 O^{22} N_3$

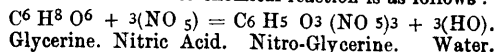
Glycerine = $C^6 H^8 O^6 = C_6 H_5 O^6 H_3$ changes into nitro-glycerine = $C_6 H_5 O_6 (NO_4)_3 = C_6 H_5 O^{18} N_3$

Carbolic acid = $C^{12} H_6 O_2 = C^{12} H_3 O^2 H_3$ changes into picric acid = $C^{12} H_3 O_2 (NO_4)_3 = C^{12} H_3 O^{14} N_3$

Mannite = $C^{12} H^{14} O^{12} = C^{12} H_8 O^{12} H_6$ changes into nitro-mannite = $C^{12} H_8 O^{12} (NO_4)_6 = C^{12} H_8 O^{36} N^6$

Here we have four of the well-known high explosive bodies, and in each case we find three equivalents (or the multiple of three) of hydrogen replaced by three equivalents of hyponitric acid.

Gun cotton looks like ordinary cotton, nitro-glycerine looks like glycerine, and nitro-mannite like mannite, but their chemical properties are vastly different. We shall speak in this chapter of the properties of nitro-glycerine. The nitro-glycerine is produced by the action of concentrated nitric acid on glycerine, during which action the glycerine takes up the nitric acid, and water is eliminated. The chemical reaction is as follows:



It is eminently necessary that the nitric acid should be employed in a very concentrated state. In the process of manufacture it is necessary to have the water which is produced in the above re-action absorbed, and that is accomplished by mixing the nitric acid with sulphuric acid.

The practical production of the nitro-glycerine therefore is accomplished by the treatment of glycerine with a mixture of concentrated nitric and sulphuric acid, in which treatment the sulphuric acid plays a secondary role, while by the absorption of the eliminated water it maintains the surplus of the nitric acid in a concentrated condition.

Different chemists employ different proportions in their mixtures of nitric and sulphuric acids, and also in adding the glycerine.

In the production of nitro-glycerine there is a very strong elevation of temperature, which must be avoided, as it may lead to explosions. There are also different methods employed to avoid this elevation of temperature.

According to Sobrero, 2 volumes of sulphuric acid of 1.831 specific gravity, and 1 volume of nitric acid of 1.525 specific gravity, are mixed, permitted to cool, and into this mixture half a volume of glycerine, of a very syrupy consistency, is introduced with constant stirring. The mixture is again cooled, and after having become turbid and been separated into two layers, poured into 15 or 20 times its bulk of cold water. The oily nitro compound sinks quickly to the bottom, is freed from unchanged acid and glycerine through repeated washing with water, and hastily dried in vacuo.

Praeger & Bertram add 1 part by weight of glycerine to 8 parts of a mixture of 1 part of concentrated nitric acid and 2 parts of fuming sulphuric acid.