AN EGYPTIAN GARDENER.

THE TOMB OF NEKHT. AND WHAT IT SHOWS AS TO HIS DUTIES.

In the Manuscript Department of the British Museum are several volumes of diaries, notes, and copies of hieroglyphic inscriptions which were made early in the present century by a certain Mr. Robert Hay, of Linplum, during a residence of nearly thirteen years in the Nile Valley. From these manuscripts it appears that he spent much time at Thebes, in Upper Egypt, where he devoted nearly all his energy to the investigation of its ancient monuments. His many portfolios of beautiful drawings bear witness to the fact that he was an artist of no mean merit, but he was also a very enthusiastic antiquarian, and, like most travelers in Egypt during the first half of the present century, he beguiled his time occasionally by digging for and opening up ancient painted tombs. Among others that he discovered at Thebes was one belonging to a man named Nekht, who held under Thothmes III., and about 1500 B. C., the office of head gardener of the gardens attached to the Temple of Karnak. There are copies of some of the wall paintings in this tomb among Mr. Hay's papers, and in his diary he roughly notes the position of the tomb in relation to the neighboring buildings. Some of these buildings mentioned by Hay are still standing, and though the tomb had long since been filled up again with desert sand and debris from the rocks above, so that not a vestige appeared above ground, they served as a clue to its whereabouts when Lord Northampton, Dr. Spiegelberg, and the writer came to explore the site last winter. Within three days of beginning operations we had, with the aid of a dozen Arabs, dug down to the entrance of the tomb, and another two days sufficed to clear it.

Like most tombs of the same period at Thebes, that of the gardener Nekht is excavated in the rocky hills bordering the Valley of the Nile on the west and overlooking the great expanse of cultivated land known as the Theban Plain. A vertical cutting of the rock has been made so as to form a kind of rough façade; in the center of this has been cut a doorway with jambs and lintel bearing hieroglyphic inscriptions giving prayers for the dead. This doorway leads into a small mortuary chapel, the walls of which are elaborately painted with scenes illustrative of the life of Nekht. At the inner end and opposite the entrance to the tomb is another doorway giving access to a small chamber or shrine, in the floor of which a vertical shaft or mummy pit leads to the sarcophagus chamber in which once reposed the body of the Theban gardener.

On the left hand wall of the small chapel is a charming little painted scene representing Nekht's private house, a mud-brick, two-storied edifice, whitewashed on the outside, with a great wooden front door. To the left of the house is depicted the garden, surrounded by shady trees and with a tiny canal running down the axis of it. This little canal feeds two small ponds in which white and blue flowered water lilies flourish; it also served the purpose of bringing water into the garden for irrigating it. Two men with yokes across their shoulders and waterpots attached to them are shown diligently watering the plants. On the south side of the house is an arbor of trellis-work, over which vines have been trained. The trees which lined the garden were not feathery date palms, but full-foliaged sycamore fig trees, under whose dense growth, Nekht says, "he cooled himself during the heat of summer, and breathed the air of the sweet north wind."

A list of trees grown in the garden of one of Nekht's contemporaries has come down to us. It enumerates sweet date and dum palms, common red and green fig trees, persea and olive trees, henna, acacia, and pomegranates, as well as vines, apples, and tamarisk trees. This list is preserved on a wall of the tomb of a superintendent of the state granaries at Thebes, and beneath it is a charming little painting showing the owner of the garden in a boat on a pond, with an inscription by the side of it explaining that "he floats on his lake and cools himself under his trees while he contemplates his avenues and reckons up all the good things which he had made on the earth."

These gardens of private individuals, however, were humble in the extreme compared to the great garden at Karnak of which Nekht had charge. A plan of it has fortunately been preserved on a wall of the tomb of another Theban official. It shows that the garden was nearly square and surrounded by high embattled walls. The principal entrance faced the river, and was guarded by a porter's lodge. In the center was the vineyard, the vines being trained on trelliswork supported by brick or stone pillars. Around the garden, immediately inside the embattled walls, was an avenue of date and dum palms, and inside this again was a row of sycamores: palms were planted also on either side of the vineyard, and in the spaces between were beds for the cultivation of rare exotics and tanks for aquatic plants. A hieroglyphic inscription records that the whole was laid out in the time of Thothmes III., which makes it very probable that Nekht was the designer.

In the reign preceding Thothmes III. attempts had been made on a small scale to acclimatize foreign plants in Egypt. Thirty-one myrrh trees had been brought from the Somali country and planted in huge tubs at Der-el-Bahari. But shortly after the accession of Thothmes III. a great number of foreign plants were introduced into the Nile Valley and planted in the Karnak garden. Many of them are figured on the walls of a small chamber of the Temple of Amen, and figured so faithfully to nature that it is not difficult to identify them. There is the Florentine flag or iris, the white-flowered lily, the ranunculus, a kind of arum, the papyrus or crinum lily, a gentian, a pink, and several kinds of water lilies, and other aquatic plants. An inscription referring to these sculptured figures informs us that all these plants came from Syria. Later in the same reign, as other inscriptions at Thebes record, flowering plants and fruit trees were imported from Mesopotamia, Arabia, the Somali country, and even the Greek islands. The Egyptian, in fact, seems to have spared no pains to grace his garden with all the profusion and variety which cultivation could obtain. They were particularly fond of sweet scented flowers, a fact worthy of notice, for it proves that, unlike the Jews and early Greeks, they were at an early period keenly alive to the sweet odor of flowers. Mr. Gladstone long ago pointed out that

Homer often speaks of flowers as "tender," "white," "hyacinthine," but never as "sweet smelling."

Nekht's duty was not merely to cultivate plants; he had also to supply his king and the priests with cut flowers and fruits for the decoration of the temple on all the principal festivals. Officially he bore the title of "purveyor of cut flowers for the god Amen." Doubtless also he supplied many of the Theban damsels with those flowers they were so fond of using for the decoration of their hair. Great quantities of cut flowers were used for embellishing the houses of the wealthy, and a blossom of some kind was nearly always presented to a guest at a banquet, just as at the present day we are given our "buttonhole" at a house party—a pretty custom, and an ancient one. In his tomb Nekht is depicted presenting Thothmes III. with a huge bouquet, five feet high, and composed of papyrus, lotus flowers, cornflowers, and poppies, interspersed here and there with fragrant fruits of the mimusopsi, a tree not now found in the gardens of Egypt, but well known at the present day in India. Some of these garlands have been found in the ancient cemeteries of Egypt, buried with the dead.—Percy E. Newberry in The London Post.

ODONTOGLOSSUM × CORADINEI, WEST BANK HOUSE VAR.

As with most *Odontoglossums*, so in the representatives of this natural hybrid between *O. Lindleyanum* and *O. crispum*, there is much variation. The ordinary forms with their narrow pale yellow segments, bearing a few brown blotches, being esteemed only superior to *O. Lindleyanum*; while the remarkable varieties, which are, however, very scarce, are fit to rank with *O. triumphans* and others of the showier section. In both good and bad forms, the long straight column, followed for the greater portion of its length by the basal part of the labellum, is a characteristic showing the affinity to *O. Lindleyanum*. The features of the indifferent varieties are distinctly those of *O. Lindleyanum* modified by *O. crispum*, while the good forms in their broader ovate-lanceolate outline show *C. crispum* changed and colored by the influence of *O. Lindleyanum*. Therefore we may conclude that the cross has been effected both ways.

The sepal and petals are ovate-lanceolate, and nearly equal in width. The ground color is lemon yellow, changing to nearly white toward the base. The sepals each bear in the middle one large chestnut-red blotch,

ODONTOGLOSSUM CORADINEI—WEST BANK HOUSE VARIETY.

about $\frac{1}{2}$ inch in length, and one smaller blotch toward the base, the margin having a chain of small red-brown dots. The petals have the large chestnut-red blotch on the outer half, the lower parts and margin bearing clusters of small red-brown spots. The tip of each segment is bright yellow. The lip, which is showier than the ordinary varieties, though of the usual form, has the blade, except the apex, chestnut red, the base cream-white with red lines.—The Gardeners' Chronicle.

MICROBES IN CO-OPERATION.

By G. CLARKE NUTTALL, B.Sc.

OF late years botanists have been made very familiar with that kind of relationship shown to exist in certain instances in the plant world which is known as Symbiosis. In these instances we find two organisms living a common life of mutual benefit, each supplying the other with some requisite of its existence, and receiving in return some essential to its own well-being. The arrangement does not necessarily benefit both sides equally, and never is the advantage of the same nature on either hand; the essential point is that there is a common life of two organisms with a mutual advantage of some kind or other. A lichen is, perhaps, the best and most striking illustration of a symbiotic union, where a minute rudimentary green plant—an alga—and a fungus, living and growing in intimate connection, give rise to that product which we term a lichen thallus. In this case the mutual benefit lies in the fact that the alga provides food for the fungus and the fungus stimulates and shelters the alga.

Metabiosis—we owe the name to the French chemist Garré—is another kind of relationship existing in certain cases which is of later recognition and not so generally known at present. For one thing, all the instances yet found of this condition are confined to the world of the bacteria, and hence do not furnish so obvious or so familiar examples as the lichens do of symbiosis; moreover, there is lacking in metabiosis that suggestion of sensationalism which caused so much interest and controversy when the double nature of the lichen household was first put forward for acceptance. Nevertheless, metabiosis, as a condition of life, has, for an interested observer, a fascination peculiarly its own.

Now, metabiosis may be broadly defined as that relationship which exists between two organisms when for one of the two to flourish and live in a certain medium it is necessary that the other should have preceded it and prepared the way for it. The develop-

ment of the one with its consequent reaction on the environment is a necessary condition of the development of the other. The first is independent of the second and in no way touches it in any intimate way; the second is wholly dependent upon the good offices of the first, for without its predecessor had lived and developed and through its living changed the character of its environment, it could never have been called into active life.

An example will perhaps best serve to illustrate the point. It was found some time ago that certain of the very finest wines produced in the vineyards of the Rhineland were made from grapes that, after they had been gathered, were allowed to stand and go mouldy and "bad," and apparently become absolutely useless and disagreeable. Yet it was from these very grapes that the wines possessing the best flavor resulted. Now, a clever German chemist, Müller Thergau, examined the matter from a scientific point of view, and he found that the mouldiness which appeared on the grapes after standing was a fungus which lived on the contents of the grapes, and which in absorbing its food changed the chemical constitution of those contents, so that when the fermentation process began through the agency of yeast organisms, they were favored and affected for the better by the changes which had already been brought about by the mould fungus. Here then the yeast stands in a metabiotic relationship to the mould fungus. The mould is absolutely independent of the yeast and appears under any circumstances; the yeast organism can only take that particular line of development, with the resulting production of "bouquet," when the way has been prepared for it by the mould fungus. It is dependent upon its predecessor for its particular action—that is to say, we have here a condition of metabiosis.

Prof. Lafar gives an instance of a whole series of metabiotic relationships when he explains, with much lucidity, the sequence of events in the evolution of wine from the grape.

The skin of the grape, he says, is naturally the home of many varieties of fungi, especially bacteria, and when the grapes are gathered and pressed down; these germs are naturally also to be found in the "must." And since the germs are of many varieties, they, of necessity, differ as to the conditions most favorable to their development and as to the length of time they demand for the various stages in their life processes.

The first to develop are the yeasts—the organisms which bring about ordinary alcoholic fermentation. These seize upon the sugar of the grape for food and split it up into carbon dioxide and alcohol, and thus at once the original constitution of the "must" is greatly altered. Another species of germs, hitherto lying dormant, then spring into activity, as the conditions are now those which most favor its development. These are the organisms which bring about acetic fermentation, for their food is the alcohol which the yeast brought into existence, and they, in acting upon it, oxidize it by means of the free oxygen in the air, and thus produce acetic acid. It is obvious that the relation between the two species is here again one of metabiosis; the bacteria producing acetic acid could not have developed in the "must" as it was in its earliest form, for no alcohol was then to be found in it; the germ might be abundantly present in the liquid, but their growth was wholly dependent on the yeast preceding them and preparing the way for them. Thus they are under an absolute obligation to the yeast, though the yeast is entirely independent of them. The result of this second stage in the proceedings is therefore a strongly acid liquid.

But now a third kind of bacteria come into play, which themselves stand in a metabiotic relationship to the second. An acid liquid is their natural home, and as the originally sweet "must" has become distinctly acidified, the dormant germs of this species are aroused into activity. They seize upon the acetic acid present, and under their influence it rapidly becomes split up into carbon dioxide and water. The bacteria accomplishing this are the thread fungi (the vinegar eel is one of the members of this variety), who thus form a third link in the metabolic chain, and their special work is the elimination of the acid.

And the thread fungi are themselves the forerunners of yet another new-comer. Certain Schizomycetes—bacteria which promote putrefaction—had entered the "must" with the dust and air in the first instance, but had had no chance of growth until this late stage, for alcohol is poison to them and acetic acid distinctly injurious. So while the yeasts were producing alcohol and the second species was replacing it with acetic acid, they were compelled to remain quiescent, and it was not until the alcohol had been removed by the bacteria promoting acetic fermentation, and the acetic acid had in its turn been reduced by the thread fungi, that the way was clear for their appearance.

The above sequence of changes thus gives us several instances of metabiotic relationship, and indeed it is probable that in most cases of fermentation and putrefaction we have much the same sort of thing happening; in all cases, that is, where several varieties of bacteria have their habitat in the same medium.

It is difficult to over-estimate the practical value which a full recognition of the possibilities and limitations of metabiosis may have. At present we can scarcely claim to do more than stand on the threshold of the new study. Up to now the aim of the bacteriologist has been chiefly to isolate single kinds of bacteria, and by cultivating them in a pure state to study each species by itself, ascertaining its exact nature and its power of work; but in the future he will find this is only the preliminary to the more complicated study of combination, and he will have his most fascinating work in combining, adding, and subtracting, in endless variation, different species of bacteria in the same medium, and thus get an infinite number of independent results. Here is a simple example of a combination that has been artificially brought about.

A certain bacterium has been found to have the power of fermenting starch into glucose, and a certain yeast, it has been ascertained, can change glucose into alcohol. Now, by putting together pure cultures of this particular bacterium and of this particular yeast into starch, alcohol can be obtained as a result of their joint efforts. This simple illustration of the power of combination merely points the way to others of greater import which may be arranged in the future, and, in fact, in judicious blending and combining probably

lies the greatest development of bacteriology in the near future.

The ripening of the curd in cheesemaking is now shown to be the work of bacteria whose home is in the milk, and this is proved by the fact that if the milk is sterilized prior to cheesemaking, no proper cheese can be produced, as the curd never ripens. But no single bacterium is responsible for the whole result, rather several species are involved, each contributing part, and part only, of the whole work, and living almost certainly in metabiotic relationships. For example, in certain investigations made by Dr. Weigmann in this matter, he found in several instances that two different forms of bacteria were present, and that a characteristic smell and taste accompanied their de-

A NEW AUTOMOBILE FIRE ENGINE.

We illustrate herewith, from *La Nature*, a new automobile fire engine invented by M. Porteu, and manufactured by M. Cambier, of Lille.

The frame, which is of U-shaped bar iron, supports both the motor and the pump.

The motor, which is a gasoline one, and is placed in the rear, consists of four explosion cylinders, *C* (Figs. 1 and 2), in pairs, placed symmetrically with respect to the longitudinal axis of the vehicle. It is of 22 horse power. The ignition is electric, and the carbureting is effected by the Longuemare apparatus.

The rods of the four pistons are assembled in two pairs upon two cranks and communicate motion to the

The pump is actuated by the shaft, *A'*, which communicates motion to the driving wheel, *M*, through a pinion keyed upon the shaft.

The throwing of the drums into gear and of the pump out of gear is effected instantaneously and automatically. A fire may thus be attacked as soon as the engine arrives upon the spot, without its being necessary to modify the running of the motor in any way whatever.

The pump, which is of the Thirion system, is capable of throwing 3,000 gallons of water a minute. Power is transmitted to it wholly by gearings, so that the inconveniences that would result from the use of belts, through the stretching of the leather under the action of the water coming from the pump, are done away with.

The steering of the engine while running is done by means of the handwheel, *V*, which acts upon the pivots of the front wheels, *R'R'*, through the intermedium of rods, *t*, and levers, *z*. Finally, the vehicle is provided with a brake, *K*, which is actuated by a pedal, *B*, placed under the foot of the driver.

As such an apparatus must carry a number of firemen with it, the fore-carriage is provided with two seats, *s* and *s'*, each capable of accommodating three persons, and with a platform, *J*, in the rear, upon which several men can stand.

This new engine has been submitted to numerous experiments in the presence of the chief of the Paris Fire Department and his staff, and of many other persons competent to judge in such matters, and has been found to operate in the most satisfactory manner.

PHYSICAL MEASUREMENTS IN ANTHROPOLOGY.

THE question of the value of physical measurements is one that lies at the base of physical anthropology. Large numbers of often very extended series of measurements are continually being published, new methods are constantly being proposed and tried; but in spite of all this, it is questionable whether the value of the results obtained is proportionate to the trouble expended. Unfortunately, there is variability in the methods employed, which may change according to the nationality of those of the investigators; some methods are complicated, like Benedikt and Toerok, or, as in the case of the latter anthropologist, who takes 5,000 measurements on a single skull, they may be impracticably numerous. Very precise measurement with refined instruments gives an apparent exactitude which appears to be more scientific than it really is. Preferable is the system that adopts a small number of measurements which can be readily made, and which have a better chance of being taken on a large number of subjects.

The extreme exactitude of cranial measurements, especially when based, for example, on the cephalic index only, has often led to creating imaginary races among a given people.

These and other wholesome warnings are uttered by O. Hovorka Edler von Zderas in the *Centralblatt für Anthropologie*, iii. p. 289, who also points out that there is no need to calculate indices to the first or second decimal, and he also states that in the analysis of a people one should not take account of differences of less than ten units in the index.

As all investigators are well aware, the cephalic index gives no information upon the real form of the skull; this has been well emphasized by Sergi, who has sought to establish a more rational system of skull nomenclature. M. L. Laloy supports (*l'Anthropologie*, x. p. 105) Hovorka's general contention, and refers to the clever visual analysis of the inhabitants of Bretagne by Dr. P. Topinard, which was published in the *Journal of the Anthropological Institute* (1897, xxviii. p. 99). In the last number of the *Journal* (new series, i. p. 329) Dr. Topinard gives the results of the trip which he made to Cornwall last year in order to compare the anthropological types there with those he had previously ascertained in Bretagne.

But in our own country Dr. J. Beddoe has long adopted a similar method of investigation, and his acute and trained powers of observation have thrown a flood of light on the problems of the races of Britain. The methods of the doyen of British anthropologists are those of the field naturalist, and there are many who realize that what is generally known as "natural history" is as integral a part of biology as is the most refined laboratory technique. It is well to use one's eyes for other purposes than for reading off scales on instruments.—*Nature*.

FIGS. 1 AND 2.—SECTION AND PLAN OF THE PORTEU AUTOMOBILE FIRE ENGINE.

velopment; but when these two forms of bacteria were isolated and cultivated separately, neither was able alone to give the specific taste and smell, and not until the companionship was restored was the original result attained.

So, too, in buttermaking. It is bacteria again who are responsible for turning the cream sour and who bring about the changes in its constitution which give aroma and flavor to the butter. Dr. Weigmann, in his observations at Kiel, discovered that no culture of single species alone could give a good taste with stability, when introduced into cream. Perfection of flavor with "keeping" properties were invariably the result of a blending together of several forms of these germs, and that if artificial souring was to be successful, a knowledge of judicious blending was absolutely necessary. This implies nothing more nor less than metabiotic relationships between the different kinds of the bacteria concerned. These instances are sufficient to indicate, at any rate, the vital importance of metabiosis in our study of the lives and works of the innumerable species of bacteria, and the great stress that must be laid on a right comprehension of this relationship in all future considerations in this direction.—*Knowledge*.

shaft, *A*, which is provided with flywheels, *V V*, at its extremities. This shaft, through a train of gear wheels, transmits motion to an intermediate transverse shaft, *A'*, which might be called the distributor of motion, since it actuates either the propelling apparatus or the pump, as may be desired. It communicates motion to the vehicle through the intermedium of drums, *M N O*, the different diameters of which furnish two running speeds that correspond to about nine and five miles an hour. These drums actuate a series of fixed pulleys, *b d*, and idle pulleys, *b' d'*, keyed upon the shaft that carries the chain sprockets, *p p*.

Transmission from the drums to the pulleys is effected by cross belts, the shifting of which from the fast to the idle pulleys is produced through the action of the rods, *h h*, which are maneuvered from the front of the vehicle by a lever, *L*, mounted upon the same axis as the steering wheel, *V*.

The intermediate pulleys, *N* and *e*, belong to the mechanism that produces a backward motion, and are connected by a belt upon which acts a stretcher, *T*, maneuvered through a handwheel, *V'*, placed under the front seat. All the belts are surrounded by an iron plate jacket that protects them from the action of the water coming from the pump.

FIG. 3.—THE ENGINE IN OPERATION.

FIG. 4.—THE ENGINE IN RUNNING ORDER.