

observed, there may be no stream of matter attached to the electric charges which carry the current. It has consequently been suggested, and with good reason, that in solids and melted metals, which conduct metallicly, the electrons are freely movable, and that this is the cause of their conductivity. There is some reason to believe that in this case also it is the negative electron which is most freely movable. Some most interesting calculations have been made upon this hypothesis, in which it has been supposed that there was something like a gaseous pressure of these mobile electrons in the metal. Thermo-electric effects have been attributed to the dependence of this pressure upon temperature, and the convection of heat accompanying electric currents has been attributed to the convection of energy of irregular motion by these electrons. The Hall effect has also been shown to be a possible consequence of a different mobility of the positive and negative electrons.

Upon these principles it is natural to attribute the magnetic properties of iron and other substances to electrons describing orbits round the atoms. These revolving electrons, in this case, represent the amperian atomic currents to which magnetisation has long been attributed. A remarkable confirmation of this has been derived from the Zeeman effect, which can be explained by the supposition that negative electrons are describing orbits round the atoms. Further, the mass that moves with these electrons has been shown to be of the same order of magnitude as the 500th part of the mass of an atom of hydrogen, which, from experiments on gaseous electronisation, seems to accompany the free electrons in a gas when it conducts.

There seems to be some reason to think that in a highly magnetisable material, such as iron, either there are more than the four electrons corresponding to its atomicity in rotation, or else that these are rotating very much more rapidly than corresponds to the vibrations of ordinary light. Some objection may be taken to the latter hypothesis from the difficulty of explaining why enormously rapid ether waves are not thereby generated in the surrounding medium, and the energy of the motion thereby lost by radiation. There are suggested explanations of this difficulty, but the other hypothesis, that matter has in it many more electrons than correspond to its atomicity, and that these latter are merely peculiar in being removable, agrees with a very interesting suggestion that all matter is built up of electrons. That an atom of hydrogen, for example, consists of some 500 electrons, one of oxygen of some 8000, and so forth. This is a natural deduction from these speculations, and receives some confirmation from its being consistent with the change in dimensions of a body as it moves in different directions through the ether which has been assumed in order to explain the experiment on the motion of the earth through the ether, which Michelson and Morley conducted. A supposition such as this naturally suggests that atoms could be built up of electrons as well as the electrons separated from matter; and if that be so, there seems no impossibility in the dreams of the alchemist, and an element of one kind may some day be transmuted into that of another. What is as yet known is, however, a very slender foundation for these speculations, and it is quite likely that matter and electricity are distinct in kind, and cannot be transmuted into one another in the way suggested.

Enough has been said in this very sketchy description of ionic theory to show how far-reaching it is; how it touches upon the confines of our knowledge and upon the borderland between physics and chemistry. Advances in our knowledge of ionic theory are likely to dispel many of the clouds surrounding the connection of matter and ether, and may lay the foundations for an intelligible structure of the physical universe. G. F. F. G.

THE RECENT CRETAN DISCOVERIES AND THEIR BEARING ON THE EARLY CULTURE AND ETHNOGRAPHY OF THE EAST MEDITERRANEAN BASIN.

WHILE recently excavating the prehistoric Palace of Knossos, which lies in the great central gap between the higher ranges of Crete, mid-way between the peaks of Ida and Dicta, I was much struck by the almost continuous dualistic style of the elements. But in this case the "eternal struggle" was not between East and West. It was North and South that here fought it out. The boreal blasts which have collected from the steppes of Eastern Europe sweep almost unopposed across the Ægean, and find their first obstacle in the long mountain wall of Crete. They pour through the central gap. Not unopposed, however; they are beaten back, and their place triumphantly taken for weeks at a time, by the parching South wind—the *Notios* of the Cretan natives—which is really the *Khamstin* of the Libyan Desert. Owing to the fact that the shoot and dumping-ground of the excavations was, perforce, at the southern end, the works were interrupted for days at a time by an overwhelming dust-cloud due to this cause, for the *Khamstin* seems to have an affinity for dust out of proportion to its actual strength. Disagreeable, however, as were these hindrances to the work of the spade, one had at least leisure to reflect on the historic lessons supplied by these natural phenomena. Crete certainly stands geographically in closer relation to Asia Minor than it does to Africa. Carpathos and Rhodes, not to speak of minor islands, afford natural stepping-stones of intercourse. The actual relations between Crete and Anatolia, ethnic and other, must not be underrated. Yet in a broad historic point of view Crete stands apart from it. It was not like Cyprus, which, although at different times it has become an outpost of Egypt and of Europe, has always remained essentially a part of Western Asia. But the main currents of Cretan history, like those of its two prevalent winds, have been Northern and Southern—European and African. Of its two direct geographical connections, that with Greece and that with Anatolia, it has consistently held to the former. On the other hand, its intercourse with the opposite Libyan coast—the Cyrenaica—and with Egypt has been singularly continuous from a very remote period. And in this lies the high importance of the part played by the island in the early history of European culture. Germs received here from the Nile Valley and its borderlands, at a time when the greater part of Europe was still in its Stone Age, were propagated northwards and westwards, and seedlings hence derived spread in prehistoric times, and by more than one channel, as far as the British islands.

During five successive campaigns of preliminary exploration in Crete, I was able to collect a variety of evidence establishing the very early derivation of certain indigenous forms of stone vases and decorative motives from those of Egypt. A series of archaic Cretan seals exhibited designs copied almost directly from those of Twelfth Dynasty scarabs, and approximately dating, therefore, from the middle of the third millennium before our era, while steatite vases were found almost indistinguishable in form from Old Empire types of considerably earlier date. The primitive three-sided seal-stones, on which appear the first rudiments of Cretan script, reproduce the type of a three-sided seal, apparently of Libyan origin, which, from its analogy with a special class of Egyptian cylinders, approximately date from the middle of the fourth millennium B.C. So long, however, as the early archaeological strata of the Cyrenaica are left as at present wholly unexplored, a great blank is still left in the materials for comparison on the Libyan side. It

remains to be seen whether the Danish expedition now organising will be able to overcome the hitherto insuperable obstacles to the thorough scientific exploration of that region, but the fanatical spirit of the Senoussi is of ill omen.

What the results of these Cretan observations have certainly ascertained is that whether directly from the Nile Valley, or indirectly through Libyan intermediaries, Egyptian elements were making their way into Crete at a period which must carry back by over a thousand years the materials for approximate chronology in the Ægean world. The derivation, on steatite seals and vases of Egyptian forms, of the Twelfth Dynasty spiral ornament (only at the beginning of the Mycenaean period taken over upon metal work) is of extraordinary importance as supplying the "missing link" in the origin and diffusion of the spiral system in the early European Metal Ages. By the Danube Valley and the course of the Elbe, the old route of the amber traffic brought this spiralfirm system to the Bronze Age population of North Germany and Scandinavia, and was by them in turn diffused, as has been shown by Mr. Coffey, to Ireland, whose wealth in gold made it the Rand of prehistoric Europe. On the other side, survivals of the Mycenaean adaptations of the primitive spiral ornament, which had lingered on amongst the Illyrian tribes of the North-West corner of the Balkan peninsula, gained a new vitality in contact with the artistic genius of the invading Celtic tribes. Assimilated by these, and transported on the wave of Belgic conquest to the North-West, the spiralfirm system of design re-entered the British Isles in another form; and in Ireland, where the elder spiral branch of the Bronze Age had long since expired—lived on to supply designs to St. Columba and his missionary fellow-workers. The chains are long ones that connect the carvings of New Grange on the one side and the illuminations of the Book of Durrow on the other with the art of Twelfth Dynasty Egypt; but they run through prehistoric Crete.

Of the intercourse between Crete and the Egypt of the Middle Kingdom the Palace of Knossos has supplied a new and striking piece of evidence in a diorite figure with hieroglyphic inscriptions, which give the character of the names it bears; its good style and material have been recognised by Egyptologists as a Twelfth, or at most, early Thirteenth Dynasty work. In other words, the latest date to which it can safely be referred hardly comes down to 2000 B.C. We have here therefore a valuable indication for the approximate chronology of the earlier elements of the Palace of Knossos itself, which in any case go back beyond the period to which the remains of Mycenæ have given a name. The high level of civilisation, however, already attained in the City and House of Minos at this remote date is shown, not only by such an artistic importation from the land of the Pharaohs as the diorite figure, but by fragments of wall-painting in an already fully developed style—one represents a boy placing crocus-like flowers in an ornamental vase—and by ceramic fabrics of great beauty. In order not to confuse the evidence, I endeavoured in this year's excavations within the Palace walls, as far as possible, to confine myself to the upper and purely Mycenaean layer, and the relics found of this earlier period have therefore been comparatively limited in number. But beneath the floors of houses immediately below the Palace and on the opposite hill, Mr. D. G. Hogarth, the Director of the British School at Athens, found a whole series of vases of this early painted class, many of them showing naturalistic designs of lilies, tulips, and other flowers, presenting shapes in some cases so graceful as never to have been surpassed in any later age of Greece. This style of Cretan pottery, which has received the name of Kamáras from the grotto where its first occurrence was described by Mr. J. L. Myres, has been found by Mr. Petrie at Kahun in Egypt, again in a Twelfth Dynasty

connection. The intercourse between Crete and the Nile Valley in the third millennium before our era has thus left its traces on both shores of the Libyan sea. The approximate date thus ascertained for the earlier part of the Palace at Knossos gives additional interest to the fact that this in turn overlays a vast Neolithic settlement, for which it supplies a chronological *terminus à quo*. In the Central Court a trial shaft was excavated, which went down 24 feet through continuous Stone Age deposits containing incised, chalk-inlaid pottery, axes and mace-heads of serpentine and other materials, obsidian knives and cores, and primitive images of clay and marble akin to those from the earliest settlement of Troy.

But the great bulk of the remains of the Palace of Knossos as yet brought to light belong to the most flourishing days of the better-known Mycenaean civilisation, and are contemporary with the Eighteenth and Nineteenth Dynasties of Egypt. The building itself is of vast extent—about two acres have already been uncovered, and beside it the Palaces of Mycenæ itself, of Tiryns, and of all other such buildings on the mainland of Greece shrink into comparative insignificance. We have not here the same mighty bastions, though the megalithic gypsum blocks of the lower part of the walls are sufficiently imposing. What we see here is the island capital of a great maritime power, the memory of which survives in that of the traditional "thalassocracy" of Minos, and which seems to have rather relied on its "wooden walls." Here are vast paved courts, propylæa, spacious corridors, and successions of magazines, and, amidst a maze of lesser passages and rooms, the actual council chamber of the prehistoric kings, with its curiously carved gypsum throne in the centre. There can be little doubt that this building was the prehistoric original of the fabled "Labyrinth," the etymological meaning of which is the house of the *labrys* or double-axe, the emblem of the Cretan Zeus. This symbol is carved on the principal blocks and corner-stones, and repeated on every side of every slab of what appear to be the sacred columns of two inner shrines. The legendary fame of Dædalus, to whom both the building itself and the works of art it contained were traditionally ascribed, is fully borne out by the actual remains. Both in painting and sculpture we see here a higher level than was reached either at Mycenæ or Tiryns. For monuments of Mycenaean painting, indeed, the Palace of Knossos stands almost alone. On many of the walls the frescoes were still found adhering, almost as brilliant as when they were executed, and we have here a new revelation of ancient painting. Quite new in ancient art were certain miniature groups of ladies in fashionably dressed though somewhat *décolleté* attire, seated in animated conversation apparently in the courts and balconies of the Palace itself. In the decorative designs and the fabulous animals, such as the griffins and sphinxes, the influence of Eighteenth Dynasty Egyptian models is evident; but these foreign elements are adapted in an independent manner. Of more special interest are life-size processions of youths bearing various vases, who display a singular general resemblance to the procession of the tribute-bearing Keft chieftains on the tomb of Rekhmara at Thebes, which dates from the first half of the fifteenth century B.C. It is known that the Kefts of the Egyptian monuments represent the Mycenaean race of the Ægean isles and coast-lands. On the Knossian wall-painting, we see them in their home.

The upper part of one of these Knossian figures, which is well preserved, is of the highest ethnographic interest, as presenting for the first time a careful naturalistic portrayal of a Mycenaean man. The profile is of a pure European character, almost classically Greek in its regularity. The lips are somewhat full; the eyes and hair are dark—the latter somewhat curly. The head is of the

high brachycephalic type. The skin shows the reddish-brown hue of Egyptian convention, just as the women are in the Egyptian manner painted white. The type of head delineated is essentially that of the race which, through all the changes of Cretan history, still remains predominant in the island. The finely-cut profile, the dark hair, the high brachycephalic skull, are as characteristic now as they were over three thousand years ago when the painting was executed. It is interesting to note that the physiognomy is distinct from the more hawk-like Armenoid type which, as Von Luschan has shown, represents the underlying ethnic element of a large part of Anatolia. It is equally non-Semitic. That this Cretan type represents that of the pre-Hellenic occupants of mainland Greece is highly probable. It still survives intact in the Illyric part of the peninsula, and I have myself been again and again struck in Cretan mountain villages with resemblances to the highland population of Albania. The Slav-speaking Montenegrins, like the Herzegovinians, so far as race and physique go, largely represent the same Illyrian element; and it was curious to notice among the Montenegrin gendarmes recently established by the Powers in Crete the striking points of similarity to the natives of the island. Here and there, in Crete and elsewhere, varieties of the predominant "Mycenæan" type take a more aquiline cast, and show points of transition to the Armenoid race of Anatolia. The cranial type is essentially the same, and on the whole the finely-cut European physiognomy, of which this Mycenæan fresco supplies the first authentic record, may be regarded as a Western differentiation of the more Eastern form.

This ethnographic result curiously corresponds with the earliest philological evidence at our disposal. A whole series of local names in Crete, Greece proper and the Macedonian and Thracian lands to the North, represent allied but differentiated versions of names common to Caria and a large tract of Asia Minor. Thus, to take a conspicuous instance, the Western area supplies a variety of names in *-nth*, like Korinthos, Erymanthos, Perinthos, Labyrinthos, answering to others on the Anatolian side having the *-nd-* sound, such as Kalandos, Oromandos, Pyrindos, and Labrandos. In this, as in its physical type and in other respects, Crete, it will be seen, cleaves to the Greek and Thracio-Illyrian world.

My own previous researches had been a good deal occupied with a class of early Cretan seal-stones containing signs both linear and pictographic in which I ventured to detect the rudiments of a pre-Phœnician form of writing. In regard to this matter the excavation of the Palace at Knossos produced a real revelation. In chamber after chamber whole deposits came to light of inscribed clay tablets undoubtedly representing the Royal archives. The character of the writing was of two altogether distinct classes—one hieroglyphic and one linear. The hieroglyphic script answered to that of the groups of characters that I had already noticed on a series of seal-stones of Mycenæan fabric chiefly found in Eastern Crete. The ruder prototypes of these with simple pictographic designs go back on Cretan soil to a much more remote period, and find, as already noticed, very early analogies on the other side of the Libyan sea. There can be no doubt that this script in its conventionalised form is the property of the old indigenous race of the island, the Eteocretes of the Odyssey. The linear writing, on the other hand, which forms the bulk of these Knossian archives, is of a very much more developed form. It is upright, of great elegance and curiously European in aspect, a certain proportion of the signs—some seventy of which were in common use—showing correspondences with the syllabic characters of Cyprus and also with the later Greek.

The pictorial illustrations which not infrequently accompany the linear inscriptions enable us in many

cases to learn the purport of these clay documents. They thus are often seen to refer to the Royal stores and arsenals, and show a decimal system of numbers akin to the Egyptian. Others, no doubt, are deeds and correspondence like the contemporary cuneiform tablets of Babylonia. Those relating to the Royal treasure show ingots, vases and ox-heads of precious metal identical with those borne by the Keft tributaries on the wall-paintings of Rekhmara's tomb belonging to the early part of the fifteenth century B.C., a valuable indication as to date. The Palace of Knossos contains no element as late as the latest prehistoric period represented at Mycenæ itself, and the date of its destruction can hardly be brought down later than, at most, the twelfth century B.C. The most recent of the clay documents contained within it lie at least behind that date.

The result of these discoveries is therefore to carry back the existence of written documents on Greek soil some eight centuries beyond the earliest known monuments of Greek writing, and five even beyond the earliest dated Phœnician record, as seen on the Moabite stone. The whole question of the origin of writing is thus placed on a new basis. The hieroglyphic Cretan forms supply, in fact, exact correspondence with what in virtue of their names we must suppose to have been pictorial originals of the Phœnician letters. *Aleph*, the ox's head; *Beth*, the house; *Daleth*, the door; *He*, the window; *Vaa*, the peg—and indeed over two-thirds of the Phœnician series find obvious prototypes among the Cretan forms. The ingenious theory of De Rougé, which has so long held the field, and by which the Phœnician letters were derived by a selected process from early hieratic Egyptian forms signifying quite different objects, becomes henceforth untenable. The analogy supplied by the Cretan hieroglyphs in favour of a simple and natural derivation is at all events overwhelming.

It does not necessarily follow that the Phœnician letters were directly derived from the Cretan; some signs, like that of the camel's head, certainly point to the accretion of Syrian elements. But the correspondences are still so great as to point at any rate to some kind of collateral relationship. Elsewhere I have ventured to suggest that these points of community may be due to the great Ægean settlement on the coast of Canaan, of which the Philistines stand forth as the representatives, and which has left its abiding record in the name of Palestine. The Biblical traditions, as is known, give the name of "Cherethim," or Cretans to a branch of the Philistine race; and Capthor, the isles or coastlands from which the Philistines traditionally came, has been plausibly identified with Keftô, the Ægean maritime realm of the Kefts, who on Egyptian monuments appear as the representatives of the Mycenæan civilisation. Of this special connection with Crete, the finds at Knossos already referred to afford convincing evidence. Other recent discoveries afford a singular support to these conclusions. It has been pointed out by Dr. Wilhelm Max Müller that in an Egyptian list of Keft names, going back to the Eighteenth Dynasty, appears the most characteristic of all Philistine name-forms, Achish; and it thus appears that the name was known in prehistoric Knossos earlier than in Gath. Not less significant in its way is the discovery made during the recent excavations of the Palestine Exploration Fund on, or near, the site of Gath, of imported Mycenæan pottery in the pre-Israelite stratum. More and more it appears that the high early Ægean civilisation, of which Crete is now seen to be the centre, was exercising a far-reaching influence on the coasts of Canaan before the rise of the Phœnician commercial power. Cadmus had sat at the feet of Minos, and the priceless gift which in darker days of her history he bore to Hellas, was in some respects at least a restitution of what Greece herself had given long before.

Gaza, the chief Philistine emporium—the crossing

point of the caravan routes between Egypt, Syria and Southern Arabia—owed its traditional foundation to Minos, and continued down to Roman times to worship the Cretan Zeus. The great cave on Mount Dicta, which was the legendary scene of the infancy of this indigenous divinity, to whom, as we have seen, the Palace of Knossos was also consecrated, has now been thoroughly explored by Mr. Hogarth, and has produced a vast mass of votive relics illustrating the prehistoric culture of Crete from the earliest Metal Age onwards. The crevices of the stalactite columns of the lower part of the cave were found to have been utilised for the insertion of bronze offerings, especially miniature figures of the double axe, which was the particular symbol of this God. Many stone libation tables were also found representing the adaptation of early Egyptian forms, and among the votive bronzes an Egyptian figure of the god Amon Ra, whose personality presents some points of affinity to the chief Cretan God. Another bronze from this site, a miniature chariot, drawn by an ox and a ram, has a special interest as an early example of a series of votive bronzes on wheels, in the shape of cars and tripods, supporting bowls, birds and other objects, which form a feature in the remains of a wide European zone during the Late Bronze and Early Iron Age. That their ultimate source was Egypt appears probable from the four-wheeled car with the silver boat of Queen Aah-hotep; but here again we see among Cretan remains what is probably the earliest European example of the class. Once more the archaeological phenomena bring home to us the fact that we stand here at the meeting-place of the North and South wind.

ARTHUR J. EVANS.

THE ASCENT OF MOUNT ST. ELIAS (ALASKA).¹

THE Italian original of this work was reviewed in our columns a short time ago (see NATURE, May 3), and we now welcome the English translation. In the preface we are informed that "the whole profit on the sale of the Italian edition, together with all royalties and rights on foreign editions, will be dedicated to an Insurance Fund for Italian Guides."

In its present garb the story of the expedition is told in simple and straightforward language, with only here and there an unaccustomed term to show its foreign origin; e.g. "In September snow-storms continue almost

¹ "The Ascent of Mount St. Elias (Alaska)." By H.R.H. Prince Luigi Amedeo di Savoia, Duke of the Abruzzi; narrated by Filippo de Filippi; illustrated by Vittorio Sella; and translated by Signora Linda Villari with the author's supervision. Pp. xii + 241. 34 photographic plates, 4 panoramic views, and 117 illustrations in text. (Westminster: Archibald Constable and Co., 1900.)

without cease" (p. ix.), and (in reference to rock-systems) "the different components of the soil of South Alaska are all stratified" (p. 232). The picturesque passages in the descriptions of the scenery have, however, lost their glow and read somewhat flat, as indeed can scarcely be avoided in a close translation. The distinctiveness of Prof. Israel C. Russell's name seems lost under the unfamiliar initials J. C., which are used throughout the book (except in the appendix, p. 232), although the full name is given correctly on p. 3. Considering the high estimation in which the citizens of San Francisco hold their business energy, it is rather amusing to read Dr. Filippi's impression that their city "being an agricultural centre, is very quiet and exempt from the feverish turmoil of the industrial Eastern States" (pp. 9-10).



FIG. 1.—Mount St. Elias from the third Newt on Cascade.

The profuse illustrations of the original are all reproduced; and in other respects this English edition is almost, but not quite, as sumptuous as its Italian fore-runner. In fact so handsome is it, that in spite of the great mountaineering achievement which it chronicles, one cannot help harbouring, like a well-known essayist under similar circumstances, a lurking desire to strip it of its fine coat to re-clothe some ragged veteran of greater intrinsic consequence.

G. W. L.

JOHN ANDERSON, M.D., LL.D., F.R.S., &c.

BY the death, on August 15, of Dr. John Anderson, in his sixty-seventh year, a serious loss has been inflicted on zoological science. Amongst the zoologists of this and other countries, Dr. Anderson was widely known and warmly esteemed. The particular branch of inquiry to which for many years before his death he had devoted himself, the investigation of the Vertebrata of Egypt, could only be successfully carried on by a naturalist who, in addition to experience in collecting, had both time and funds at his command, and who also possessed sufficient energy and tact to ensure the