PAPERS

ON

THE GREAT PYRAMID.

ST. JOHN V. DAY.

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ON

THE GREAT PYRAMID;

INCLUDING

A CRITICAL EXAMINATION

OF

SIR HENRY JAMES'

"NOTES ON THE GREAT PYRAMID OF EGYPT."

BY

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TO

C. PIAZZI SMYTH, F.R.S.S.L. & E.,

Astronomer Royal for Scotland, Professor of Practical Astronomy in the University of Edinburgh,

THAN WHOM THERE IS NO MORE SINCERE

INQUIRER AFTER PRIMEVAL TRUTH IN ITS MOST

COMPREHENSIVE AND ENLIGHTENED SENSE,

These Papers are Inscribed,

NOT ONLY AS AN INDEX OF PERSONAL FRIENDSHIP,

BUT ALSO AS AN ACKNOWLEDGMENT OF

THE EMINENT SERVICES HE HAS RENDERED IN

PROSECUTING INVESTIGATIONS OF SUCH VAST IMPORTANCE

TO MANKIND.

PREFACE.

THE following pages have been written during some of those short intervals of leisure which I have been able, though actively employed in professional pursuits, to dedicate to the investigation of a subject that in richness as a field for research and for elevated character is not surpassed; a subject by the greater portion of the literary and scientific world looked upon with disfavour, yea, even with suspicion—such being an almost necessary result in many cases by reason of the labour of investigation requisite to its right and complete understanding; nevertheless, one needing but to be more carefully dealt with by those who turn attention to it, in order to be rightly appreciated.

A former published Work on the subject, besides one or two Papers in the Transactions of a Scientific Society, have of necessity brought me into contact with every shade of opinion, as to the various theories respecting the Pyramid and the facts belonging to it, which from time to time, from age to age rather, have been propounded and brought to light. I have thus been enabled, both by verbal and written discussions and arguments, to ascertain the weight

of evidence on which theories, assertions, contradictions, and alleged facts, have been supported; and I can only state that in those cases where the Pyramid subject has been examined into with a diligent spirit of inquiry, that is with the aim of not merely strengthening preconceived notions or prejudices, but to evolve absolute realites, I have not yet met anyone but who is more or less convinced by the modern theory originated by John Taylor, and based by him upon the admeasurements of Howard Vyse and Perring. On the other hand I have met many, such as are always to be found, no matter what the subject is, who declare against it; but who on being questioned, do by the very peculiarity of their opposition, show to what extent they have given themselves the pains to comprehend it to the full.

To myself, the chief matter of regret which I entertain is, that some one more able had not taken charge of the duty, which, however poorly, it has been my endeavour to fulfil, in exposing the gross misrepresentations pointed out in the following pages as existing in a recently published official document.

The style of writing—that of exact criticism—became imperative for reasons which will shed their own light on the reader as the investigation is passed through; this I can but regret, yet the circumstances were none of my own controlling.

With regard to the first Paper, the proof sheets of the greater part of it were submitted to Sir Henry James before the edition was thrown off; as I considered it only fair to afford him the opportunity of correcting any of his errors either in arithmetic, fact, or history, beforehand.

The two other Papers were written about two years ago, but they have not been previously published.

The first Paper would not have been written, but for Sir Henry James himself having opened and continued a correspondence on the Pyramid with me up to the time when the Mount Sinai and Great Pyramid Survey Expedition was organized and started from this country, a correspondence wherein he laid the foundation of what was afterwards to appear in his published "Notes;" so that I felt, and was advised by others, that the onus of exposing his misconceptions and perversions rested in my hands. If any other reason for what I have written is asked of me I have none to give, other than the promptings of duty to expose fallacies so authoritatively flung into the midst of mankind. The truth is as I have told it.

If the Papers have numerous and great shortcomings I could not avoid them, but still venture to hope they contain a few things worthy of notice; and in conclusion can only say, as others have already said, with the unassuming writer of the Book

ii. Macc. 15, 38. of Maccabees, "If I have done well and fitting the story, it is that which I desired; but if slenderly and meanly, it is that which I could attain unto."

ST. J. V. D.

GLASGOW, *September*, 1870.

ON SIR HENRY JAMES' CONTRIBUTIONS

TO THE LITERATURE OF

THE GREAT PYRAMID.

I.—On November 9th, 1867, Colonel Sir Henry James, R.E., in writing to the *Athenæum*, under a heading, "The Great Pyramid of Egypt,"* asserted that "the *length of one of the sides of the base of the Great Pyramid is precisely* 360 *derahs or cubits of Egypt.* This can scarcely be regarded as a mere accidental numerical agreement. The derah is a land measure still in use, and is stated by Woolhouse, in his 'Weights and Measures of all Nations,' to be 25·488 inches in length; but 25·488 inches × 360 = 764 feet, *which is the exact length of one side of the base of the Pyramid,* 'with the casing stones,' as measured by Colonel Howard Vyse."

The degree of exactitude professed by the investigator is marked by the two sets of words which the writer has italicised in the preceding quotation. Surely, then, it will generally be admitted that the least feature to look for in any endeavour at expounding the proportions and dimensions of such a structure, over the nature and objects of which

* *Vide* Appendix A.

men through all ages have so severely contended, is, that the arithmetic involved had been keenly eyed, and its results faithfully stated; for, after all, precision of language, that is to say, of mere words, in no case, more especially in such an instance, is of any importance, where accuracy of numerical statement as to the results is either wilfully or unconsciously set aside.

It is barely necessary to mention here, that above every feature in the whole structure, our closeness of approach to a perfect knowledge of the true proportions of the Great Pyramid depends on a precision of linear measures, which (in so important and universally recognised a ratio* as that which it is believed was with exactitude expressed in the dimensions of the original perfect building) is seriously affected with every few inches by which these measures may be given in error; yet all the while, the Director-General of the Ordnance Survey has not scrupled to treat as unimportant not merely an inch, or even two or three whole inches, but really 0·64 of a foot = 7·68 British inches, for he puts it thus—

$$\underset{\text{Inches}}{25{\cdot}488} \times 360 = \underset{\text{Feet}}{764}$$

whereas this result is by 0·64 of a foot too small, that is to say—

$$\underset{\text{Inches}}{25{\cdot}488} \times 360 = \underset{\text{Feet}}{764{\cdot}64}$$

* The ratio of a circle's radius to its circumference = 2π.

Lest it should be thought by any who perchance may read this page, and who have not studied the geometry of the structure on which it touches, that the writer is bent on hypercritical error-finding, and that, too, over quantities which may seem to them, in comparison with the huge dimensions of the building, as utterly trivial, he would only here add, in self-defence, that the arithmetical error alluded to at this place (the very outset, indeed) well nigh vanishes when it is brought face to face with misstatements of whole facts, make-believe results, which the factors employed cannot produce.

The writer has above remarked that, by every few inches with which the true length of the dimension under consideration is given to us in error, the resulting ratio of height to base is seriously affected; and as he is desirous here to propose nothing but what can be completely proved, he accordingly, to set this assertion at rest, deems it the better course to resort at once to a trial; and that, too, with the same figures which Sir Henry James has chosen, viz., those of Colonel Howard Vyse, but which are well ascertained as being circumscribed with serious departures from precision. Nevertheless, taken as they are, they are sufficient to bear out the truth of what is above stated.

Colonel Vyse gives the Pyramid height as = 486 British feet, and the base = 764 British feet. Now, using these figures on the π theory (which Sir Henry James admits, and thus, although from an opposing

standpoint, has happily done his part in testifying to one great fact enshrined in the primeval Pyramid), we find

$$\frac{764 \times 2}{486} = 3{\cdot}1440;$$

or, as compared with the usual arithmetical approximation of π —

$$3{\cdot}1440 - 3{\cdot}14159 = + 0{\cdot}00240 \text{ in error.}$$

Yet, if we add half a British foot only to this 764 (and which is much less than the error by which the base length is misrepresented in the *Athenæum*), we get a resulting ratio in which the error is very nearly doubled, or as the figures themselves show—

$$\frac{764 + 0{\cdot}5 \times 2}{486} = 3{\cdot}1460$$

and

$$3{\cdot}1460 - 3{\cdot}14159 = + 0{\cdot}00441.$$

How much more serious, then, is the indifferent treatment of 7·68 whole inches? which considerably more than doubles the error from the true or closest practically used approach to the value of π. Inevitably, then, the writer cannot avoid the counter-assertion that the figures which Sir Henry James has used prove that the length of one side of the base of the Great Pyramid is *not* precisely 360 derahs, or units of 25·488 inches.

The derah is stated by the Ordnance Survey Director-General to be "a land measure still in use."

Accordingly, if this same measure is that by which the Pyramid's base length was set out, it must have been devised 4000 years ago; and if it be the case that in Egypt the standard unit of linear measure has been preserved through such ages in a land which has encountered such vicissitudes, and yet has not varied by even the smallest fraction, even so that it will fit into the Pyramid's base to-day with the same exactitude as it is now professed to have fitted in the day of its founder, how greatly must we not marvel at the comparatively enormous errors which have crept into our own and all modern metrical units; so much so, that, from various causes, their true length cannot be exactly stated, and we are compelled to show our shortcomings of the appreciation of a true standard by an inevitable + or − quantity, in face of the existence of this immutable derah, which, if what is now asserted for it by the officer at present in charge of the Ordnance Survey in Great Britain be fact, must have been the forerunner of the imperious principle which has been recognised as embodied only in the imaginations of the Median and Persian legislators.

Such an unalterable, and so primeval a possession of mankind—older even than Abraham himself—does Sir Henry James declare this derah to be, that surely it must possess an unparallelled interest to the living nations of to-day. Hence, then, the writer has felt it his duty to consider the weight of evidence upon which the assertion rests.

Colonel Sir Henry James quotes the length of

the derah from Mr. Woolhouse, the writer of a small volume on the "Weights and Measures of all Nations" in Weale's Rudimentary Series: a series, by the way, to which in our school-days many of us have been indebted, but it will scarcely be believed that any high professional man versed in the methods of science and seeking for *standard* information would consign himself thereto, and thereon rest his researches.

Immediately after the appearance of the letter in the *Athenæum*—a journal wherein it was certain to engage the attention of some observant minds—the weight of probability upon which the asserted length of the derah rested was ably investigated by Mr. Petrie,* and that alongside of a standard unit which the modern investigators of the Great Pyramid have developed as being recorded in the length of its base side, namely 25·025 British inches; but with this latter we will not deal at present further than by stating that Mr. Petrie's research points out the weight which should be assigned to either of the numbers.

As chief among other reasons for assigning a foremost place to the derah, and for so directly connecting it to the Pyramid, is the assertion because it exactly divides that building's base-side line into 360 equal parts; hence, then, either 360 of these derahs happened to be fixed upon accidentally by the builder, or, to take the alternative proposition, it was so specially recognised a number,

* "Antiquity of Intellectual Man," by C. Piazzi Smyth. Appendix I.

and being of so much importance, was therefore pre-eminently chosen before any other number. If we, then, enquire as to the special references or uses of 360, we find one only, namely, the division of the circle; and this division is on trustworthy ground believed to have been the work of Babylonian astronomers (if, peradventure, we may distinguish them by so exalted an appellation), as in the very choice their ignorance of fact is emblazoned, for they are believed to have so divided the circle because they thought there were 360 days in the year: and although it has also been proposed by some that whilst these Babylonians really knew the exact uneven number of days in the year, 360 was chosen because of its being a whole and divisible number, and therefore more convenient than the larger and fractional quantity; yet the writer ventures to throw discredit on this latter aspect, for it seems to him that if the Babylonians were really accurate in their knowledge of the true quantity representing the earth's revolutions in traversing her complete orbit, or of methods by which the real quantity is obtained, it is scarcely conceivable but that they should also foresee the tendency to introduce further errors and perpetuate blunders; in fact, create interminable difficulties by the institution of a concrete quantity purporting to have such sublime significance.

Assuming even, that this same number was represented by the division of derahs into the Pyramid's base, it is clear that such a division could have nothing to do with the Babylonian quantity, for the

Pyramid preceded the independence and activity of Babylon by about 1500 years. Hence, then, we are forced to the conviction that, if the alleged derah value is the 360th part of the original Pyramid's base-side, it is merely *accidental*, and not resulting from any prime importance being at the time of the building attached to that quantity. The derah is said by Sir H. James to be a "land measure," and, therefore, some one may urge that it was consequently of immense importance, and so was, of course, with set purpose embodied. Whilst the writer admits the force of this suggestion, yet he is also bound to point out that, if the perpetuation of the derah was the object, still the choice of 360 of these must have been an affair of secondary or rather dependent importance, and a mere result from some other influence primarily governed by altitude or angle. Almost needless, from the writer's point of view, is it to have been at the pains he has used to point out the flimsy basis of the proposed base-length and derah connexion without looking into the more important question as to whether either of these have been truly stated, at least as closely as a value can be assigned to them from the data possessed of both ;* therefore, it has now to be inquired, 1st, What was the original length of the finished Pyramid's base side? and, 2nd, Is the derah an even division of it?

* It is not unimportant to remind the reader that the idea of a primeval metrical standard being embodied in the Pyramid's linear measure is no modern expectation solely; for Sir Isaac Newton, and others, besides Piazzi Smyth and Sir Henry James in our own day, foresaw the necessity of the Pyramid being appealed to.

The only admissible approximations we possess of the Pyramid's true and ancient base-side length, as defined by the all-important sockets, are those given by Howard Vyse, the measures of the French savans (repeated apparently by Mahmoud Bey), those of Mr. Inglis (taken for his employer, Mr. Aiton, and in conjunction with Professor Piazzi Smyth, by whom, with the consent of Mr. Aiton, they were first published to the world in "Life and Work at the Great Pyramid"), and, lastly, that of the Royal Engineering party, in their recent return from the Sinai Survey; the quantities assigned by each of whom stand thus, including a deduction from the first three by Piazzi Smyth :—

	British Inches.		British Feet.
Vyse, for One side, viz., the Northern,.....	9168	=	764·0
French Savans, for the same side,.....	9163·44	=	763·6
Aiton and Inglis's mean of Four sides,.....	9110	=	759·2
Piazzi Smyth's concluded mean,.....	9142	=	761·8
Royal Engineers' mean of Four sides,.....	9130	=	760·8
The same, corrected by Sir Henry James,...	9120	=	760·0

How, then, with any of these six quantities, or the mean of the six—or, with what is most probably the closest approximation to the truth, namely, the mean of the two first—does the derah value of 25·488 inches stand? Precisely thus does it stand, viz., that it is not an even 360th division of any of them; for 360 times the derah = 9175·68 inches, or more than any one of the whole side's contents! What more, then, need be said of the suggested derah and base relationship, but that it is untrue in fact.*

* It should be explained, that whilst there appears, on a totally independent testimony, to be good reason for assigning greater weight to the

The writer cannot do better, in concluding this section of his commentary, than quote Mr. Petrie's words :—

"The best that can be said of the connexion of such existing Egyptian measures with the base of the Great Pyramid is, that if the existing Egyptian *gasab* (for this will suit the case better than its fourth part, the *derah*) be descended from far beyond historic antiquity, or even probably so, and its ancient length were (101·839) = ·113 of an inch, or about 1-1000th part shorter than our present (Sir Henry James') information assigns as its existing length, it would then become probable that this measure was *derived* from the Pyramid's base."

But is there any such measure, *i.e.*, in assigned length? for the name of *derah* is merely Egyptian Arabic for cubit, and is equally used for cubits of various lengths, and of known foreign introduction, within recent times.

II.—After Mr. Woolhouse's derah value of 25·488 inches had been questioned, as before alluded to (*vide* page 8), Sir Henry James himself suddenly lost faith—or acted as though he had—in his own positive assertions and claims for that derah which has now been discussed; it behoves us, therefore, to look

measures of Vyse and the French, than to the more modern ones (unless these be corrected for instrumental and coincident local errors) of Inglis in 1865, and the Royal Engineers in 1869, chiefly due to the difficulty of obtaining a true measure now-a-days, caused by the vast rubbish mounds lying between the terminal sockets, which (mounds) have increased so much since the days of the earlier measures, as clearly pointed out in "Life and Work at the Great Pyramid," yet the Royal Engineers have still come home with merely another bad measure, or a measure not one whit more reliable than any which preceded it—indeed, from obvious causes, less so—whilst the haste and spirit in which the work of measuring appears to have been done, can by no means tend to teach men to look to it with respect.

into his further dealings with the questions at issue. Sir Henry James has not endeavoured to confirm his original assertions by seeking out further proof of the derah value which he had previously employed, nor has he sought to eliminate his own errors in stating the base measure; but, finding the hollowness of his assertions woefully exposed, he quietly throws them overboard, abolishes the 25·488 inch derah entirely, and in a letter to the *Athenæum*, dated August 1, 1868, says:—

"The accuracy of Woolhouse's length of the Egyptian cubit has since been questioned, and this has led me to a further investigation of the dimensions of this (the Great) Pyramid—or, I should rather say, of the units of measure employed in its design or execution;* *for we may consider* 763·6 *feet as the true length, from corner to corner, of the sockets* which were cut into the rock at the four corners of the Pyramid, to receive the corner stones. *These sockets are* 8 *inches deep*, and the Pyramid was surrounded with a pavement 1 foot 8 inches† in depth, by which the length of the sides would be diminished 2 *feet* 11 *inches at each* end, and the side of the visible finished Pyramid would be reduced from 763·6 to 757·5 feet; and as no one ever designed or spoke of the dimensions of any building but with reference to the work which was visible and finished, we may consider 757·5 as the true length of the side of the base.

"Now, Herodotus tells us, Euterpe, 168, that the arura or Egyptian acre 'contains a square of 100 Egyptian cubits,' and I infer that the side of the base was made 500 of these cubits, and that the area of the base was therefore exactly 25 aruræ. This would make the Egyptian cubit equal to 1·515 English feet, 500 × 1·515 = 757·5 feet, *the length as measured*. But 1·515 feet, equal 18·18 inches, is the length of the Egyptian cubit given in the great work of the French savans, 'Description de l'Egypte,' and described by them as the 'coudée des Grecs d'Hérodote, juste,

* The italics in this quotation are now introduced by the commentator.

† Since altered by Sir H. James to 1 foot 9 inches in a private communication to me.—Sr. J. V. D.

médiocre, commune des Arabes = 0·4618 metre.' The Egyptian cubit, according to Herodotus, being equal to that of Samos.

"The height of the Pyramid above the plane of the pavement was 481 feet. The chambers and passages of the interior were set out with the cubit of 20·699 inches, *i.e.*, of the same length as that of Karnak, which is preserved in the British Museum. The arrangement of the passages was obviously made to facilitate the transport of weights, including the King's body in its case, from the entrance to the centre. The inclination of the ascending passages being made equal to that of the descending, a weight on a truck at the bottom would counterbalance, by means of a rope and a pulley, a load descending from the entrance to the point where the passages meet, and be itself drawn up towards the same point, and it would counterbalance the same load when it is being drawn up the ascending passage to the centre, whilst in the same time it descended to its original position. A very slight amount of mechanical skill would be required to re-establish such a mechanical arrangement for visitors to the interior of the Pyramid."

(Signed) HENRY JAMES, Col. R.E.

A reprint of the letter from which the preceding quotation is made was enclosed to the writer in a letter from the author himself, who thereby spontaneously opened up a correspondence on the subject, the first letter being dated August 17, 1868. In this letter the author, in a circuitous way, asked the writer's judgment of the part he had taken in Pyramid investigations. Knowing, as Sir Henry James must, from having read a paper on the subject in the Proceedings of the Glasgow Philosophical Society, that the writer held views directly opposed to his own, he must surely have been sensible that the writer could not homologate such wholesale confusion, such an attempt to promulgate fiction for truth, such stratagem to subvert realities, as that which he had

employed. Accordingly, the writer could not do otherwise than reply to the letter, by exhibiting his extraordinary errors, a task most unsought for, and most distasteful to his own feelings; yet, before proceeding to commit to writing a statement of the extraordinary errors, in deference to his own feeling of dislike to wage a scientific warfare with anyone, more especially one who had volunteered to address him from so elevated an office in the scientific departments of Her Majesty's service, he deemed it proper, first, to reply to the letter by asking if Sir Henry James really wished him to express in writing his views as to the part he (Sir Henry James) had played in reference to the Pyramid, stating that, if he did not hear to the contrary within a certain time, he would write down and transmit the conclusions drawn. To this letter no reply was received within the time named; accordingly, Sir Henry James was written to as desired. In order, then, to make it clear that the errors were straightforwardly pointed out to the Director-General of the Ordnance Survey shortly after he laid his assertions before the writer, he deems it right now to print a portion of the letter which was written on the occasion, for, by so doing, the present purpose in exposing the style of the investigation will be partly met:—

Extract of Letter to the Director-General of the Ordnance Survey, dated 25th August, 1868.

"In your letter to me, dated the 17th inst., you state that 'In the geometrical figure of the Great Pyramid we should be sure to have preserved a record of the units of measure employed in its

design, and you, as an engineer, will be able to judge whether I have been able to correctly determine them,' thus tacitly referring me to the papers published over your name in the *Athenæum* for November 16, 1867, and August 8, 1868, respectively. In my reply to your letter under reference, I stated that 'it appeared from the mode in which you expressed yourself, that you desire to have my opinion on the part which you have taken in the recent discussions concerning the testimony of the Pyramid, and that if I did not hear from you to the contrary within a few days, I would do myself the favour of writing down and transmitting to you the views which I had formed thereon;' and as I have since then received no further communication from you, I proceed to consider the matter. At the same time, I beg to remark that, if the necessity of the case should cause me to be a little severe in what I have to say, I sincerely beg your indulgence.

"In your letter to the *Athenæum* of August 8th, you allude to your previous letter to that journal, in which you had propounded a theory as to the proportions under which you believed the Pyramid had been erected, also mentioning what you believed to have been the unit of measure employed by the builders; but as the accuracy of the unit of measure then proposed has since been questioned, it has naturally enough seemed to you desirable to re-investigate your previous grounds for concluding as you did, and you now find it necessary to abandon *in toto* what you had previously arrived at, for the sake of adhering to what you are pleased to consider a more recent and convincing discovery, and which, from having published the ideas *leading* up to it in a Metropolitan weekly journal, we are bound to conclude that you consider as unequivocal and ultimate.

"Pray allow me to follow you throughout this last investigation. You formerly took 764 feet for the base length, and now assert this as erroneous, by declaring the base length to be absolutely 757·5 feet, whilst the fact is, that on the only first-rate occasion of the base side being well measured—namely, in 1799, by the French savans—they determined the length of the base at the north side of the structure to be 763·6 feet; and you explain that we must nevertheless take your now alleged 757·5 to be the true length, because you affirm that the base was surrounded with a pavement 1 foot 8 inches thick, and that, therefore, the French measured length must be diminished to the distance between two points at the

corners of the original stone casing, at a height of 1 foot 8 inches above what has always by every authority been considered as the bottom of the original finished Pyramid. This deduction of 1 foot 8 inches from the Pyramid's height will have the effect, *you say*, of diminishing the base length by 2 feet 11 inches *at each end*—but do you really mean to assert this seriously, or suppose that anyone will accept it without testing the accuracy of your arithmetic? And on testing it, what do we find—nothing short of an error, so large and so obvious, that it is beyond conception how you could have overlooked it; but here it is, and I trust my pointing it out now will enable you to correct it ere it be too late to attempt to do so. Taking θ (angle at base of the Pyramid) $= 51° 51'$ as the best ascertained value, and P = 1 foot 8 inches (thickness of your alleged pavement), then B (the horizontal distance from a point on the side of the Pyramid 1 foot 8 inches above the present base to a perpendicular raised from the line where the base and pavement *really* meet) is not 2 feet 11 inches, but 1 foot 3·7 inches, which, being doubled and subtracted from the length given by the French Savans, would make your alleged base line not 757·5 feet but 761 feet.

"Your assertion that the Pyramid was surrounded with a pavement of such a height above the absolute base, is a piece of information of which no one had previously heard, for Col. Howard Vyse explains that the pavement was certainly *under* the sloping sides,* except at the four corners, where sockets were cut to receive the four lowermost corner stones—and to Col. Vyse we certainly may trust completely, whilst he is the only modern authority who had the opportunity of seeing the two casing stones remaining in his day and the pavement, so it is perfectly clear that the base length, as measured by the French, needs no correction for any upraised pavement which never existed.

"You then assume that the base length contained 500 of a certain alleged cubit, equal to 1·515 English feet, or 18·18 inches long. Now, it is confirmed by all reliable authorities, including Sir Gardner Wilkinson and Wm. Osburn, that the cubit in *ordinary* use never varied in the early ages from 20·7 English inches very

*Nay, he even gives a Plate, the frontispiece to Vol. I. of his "Pyramids at Gizeh," where he shows the pavement absolutely going in under the casing stones, that is to say, having them resting *on* it.—*Footnote added October 23, 1869.*—St. J. V. D.

nearly; and, in reply to a recent enquiry, Professor Smyth informs me 'that the assumption of 18·18 inches as the length of the Egyptian cubit in the days of the Pyramid depends on no more than this, that the Greek cubit was of that length nearly, and when the Greeks overran Egypt, 1500 years after the Pyramid had been built, they brought that cubit with them,' so that you have now to show how the builders of the Great Pyramid came to know of the Greek cubit 1500 years before it was imported into their country.

"You then go on to say that the height of the Pyramid above the pavement was 481 feet. Now the best deduced height from all the measurements show it to have been (when the Pyramid was entire) 486·2 feet, so that, if we even substitute this 1 foot 8 inches of pavement which you declare for, we do not get 481 feet, but 484·45 feet.

"Hence the whole conclusion that one can arrive at, I regret deeply to say so, is, that your deductions are of no value whatever and entirely erroneous, because they begin upon false assumptions, and from first to last are full of the gravest errors in simple arithmetic.

"The latter remarks in your letter, published August 8th, are as amusing as they are impossible. I allude to the employment of ropes and pulleys in the passages. It would have been prudent to reconsider all the facts of the structure before propounding such an assumption; besides, I may most reasonably ask for your authorities as to the knowledge of the rope and pulley in the day of the Pyramid's building."

Hence then, under the single plea of Mr. Woolhouse's linear value of the derah being questioned, Sir Henry James reforms one and every part of his previously very confidently asserted dimensions, and insists, 1st, the base to be no longer 764 feet, but 757·5 feet; 2nd, that the important number to determine the size of the greatest builded monument is not 360, as he formerly declared for, but 500; and 3rdly, that the ancient Egyptian

cubit was not 25·488, but so small a thing as 18·18 inches, and he finally exults that $18{\cdot}18 \times 500 = 757{\cdot}5$ feet, "the length as measured." All this is asserted so strongly, and by the Director General superintending the Ordnance Survey, that the public may be ready to accept it at once; but inasmuch as the assertions in all their particulars for totally different quantities, were just as strong on the former occasion above noticed, it certainly lay across the writer's path of duty to point them out, and the more especially, that on this second occasion they are based on nothing short of a triple error.*

The letter above given, long as it was, was not even long enough to point out all the errors in the several assertions, for in view of this the writer need but allude to what is said regarding the corner sockets, which are asserted to be 8 inches deep, yet compare this with the various measures of every one of them, given by the only men who have ever seen them, namely, Messrs. Aiton and Inglis of Glasgow, Civil Engineers, and the Astronomer Royal for Scotland,† from which we learn that they are all on different levels and all of different depths, so that, on the socket question, there is not the shadow of a reason for concluding that 757·5 feet was the length of the base of the original finished Pyramid.

Hence, then, a weaker theory at all points was

* The conclusions on the second occasion were subsequently reviewed in the *Athenæum* by Mr. Petrie. *Vide* Appendix C.

† "Life and Work at the Great Pyramid," by Piazzi Smyth, Vol. ii., p. 137.

never put forth than Sir Henry James' *second* attempt to settle why the Great Pyramid was made of the size we find it to be; whereas, in dealing with the question of the angle of the passages, he omits altogether to notice the remarkable astronomical azimuth and the delicate adjustment of their angles of altitude, which have given other men, as Sir John Herschel, such especially interesting and important problems in astronomical chronology to investigate; nay, but puts forward his wheel, pulley, and weight transport notions, which are too ridiculous to waste words upon.

Not receiving any acknowledgment of the lengthy communication made to the Director General of the Ordnance Survey, the writer had begun to suppose that he had abandoned the subject, but whilst travelling in the South of England in the following September, this letter reached him:—

MOSSGAIT LODGE,
ISLE OF LEWIS, 12*th September*, 1868.

MY DEAR SIR,

I am sorry to have put you to the trouble of writing so long a letter respecting the Great Pyramid, and to find that you do not agree with me in thinking that it was built according to the simple directions I have supposed to have been given for its construction, viz., to make the rise at the corners 9 in 10, and to make the side of the square base 500 cubits, and its area 25 aruræ.

Any other view of the subject seems to me to be mere moonshine, but I may be wrong for all that.

I am, my Dear Sir,

Your obedient Servant,

(Signed) HENRY JAMES.

ST. JOHN VINCENT DAY, Esq., C.E., &c.

The tone of this letter made clear to the writer's mind that something had happened which perhaps the Director-General little suspected, viz., that some one would test the accuracy of his arithmetic; for it is not unusual, when a proclamation is issued from so elevated an official source, for men to accept the dicta as infallible, therefore they do not frequently deem it worth while to investigate the truth for themselves; but, under the circumstances, it would at least have looked better in the eyes of men of science, if Sir Henry James had, without resorting to slang words, had the candour to confess the discrepancies in mere multiplication, addition, and subtraction into which he had so positively fallen, yet not a word of acknowledgment over blunders that a mere schoolboy at his class would be well chastised for. The writer could not, then, do otherwise than express himself in reply as in the following abstract:—

GLASGOW, *October* 28, 1868.

MY DEAR SIR,

Your letter of September 12 was forwarded to me in Devonshire, and I regret in having been prevented from replying to it earlier. Not that in reality there is any necessity for reply after the statement of your views in so positive a manner, at once indicative of your fear to submit those views of the great Pyramid which you have propounded to the crucial test of examination, based upon *ascertained facts*, and the unerring laws of simple arithmetic and geometry. It is too palpable a sign of weakness, when errors are pointed out, to shuffle away from argument in the manner you now try to avoid calm and fair discussion.* Such positivism characterizes all which you have written, whether to the public press or to me privately, on these

* The reader must not forget that Sir H. James, quite unsolicited, commenced the argument with the writer.

Pyramid questions, that I am disposed to doubt whether you have ever really given due consideration to that side of the question which is opposed to what you take.

It is, however, to be hoped from the words with which your letter concludes, that you have not concluded with the subject but intend to pursue it further, as opportunity may offer; and may I venture to hope that closer investigation will—under the guidance of equal avidity which has marked your previous enquiries concerning the wondrous work of the first engineer—lead you to understand how accurate his work is, and free from those blemishes with which so many of our friends deplore to find you have endeavoured to stigmatise the designer. May it lead you to be reconciled to views as different from those published in the *Athenæum* of August 8th last, as they differ from your first arrived at conclusions published in the same journal, and dated November 9, 1867.

If after you acknowledge your extraordinary arithmetical errors, so palpable, indeed, as to form ground of complaint to the most inaccurate mind, you shall then conclude in the true sense of the term, that the view of the Pyramid which I have adopted is "mere moonshine"—I shall then, as I do now, feel most happy in your having confessed that the exalted ideas of "moonshine," as well as "the Pyramid," appear to owe their origin, most probably, to one and the same source.

I am,

Your obedient Servant,

(Signed) ST. JOHN VINCENT DAY.

COL. SIR HENRY JAMES, R.E., &c.

During the time that the foregoing correspondence was being carried on, the expedition for surveying Mount Sinai was being organized, chiefly under the auspices of the Palestine Exploration Association, and the public was appealed to by lecturers and advertisements for subscriptions; but not until now did it appear that the Royal Engineers were to survey the Great Pyramid on their return home.

In a shortly succeeding number of the *Athenæum*, appeared the following communication :—

ORDNANCE SURVEY OFFICE,
SOUTHAMPTON, *November* 23, 1868.

The expedition under Captains Wilson and Palmer, R.E., arrived at Suez on the 8th inst., and was to camp at Ain Musa on the 11th, on their way to Jebel Musa. The work of the survey has therefore been commenced, and it only remains with the public to say whether, by their contributions to the cost of the survey, it shall be completed. If the party should have time for the purpose, I have instructed the officers to measure and bring home an accurate plan of the Great Pyramid; strange to say, no accurate plan of this Pyramid yet exists. The French savans made the length of the side of the Pyramid about 746 feet, and the distance between the sockets at the four corners about 764 feet, agreeing very closely with the measures of Vyse and Perring. These numbers give 9 feet as the breadth of the casing stones, and therefore, the distance from the corners of the Pyramid to the furthest corners of the sockets 12·7 feet, that is, the diagonal of the square of 9 feet. But in the French plan this distance is made about 29·2 feet or 350 inches, and the Astronomer Royal for Scotland, from his "own measures," made it also about 350 inches at each of the four corners. These numbers are utterly irreconcileable; in one case, the finished Pyramid with its casing stones would entirely cover the sockets cut in the rock, *which are about* 12 *feet square;** and in the other, it would not reach to the nearest part of them.

Whilst such discrepancies exist, it is impossible to say what was the real length of the side of the Pyramid, or the relation of the Pyramid to the sockets. These points I hope will be cleared up by our surveyors, and we shall then have, I believe for the

* These words are italicised by me, as the sockets are respectively of widely differing dimensions, not one of them being even approximately square. See "Life and Work," Vol. ii., pp. 134, 5, 6, and 7. —ST. J. V. D.

first time, trustworthy data for discussing the units of measures employed in the design of the Pyramids.

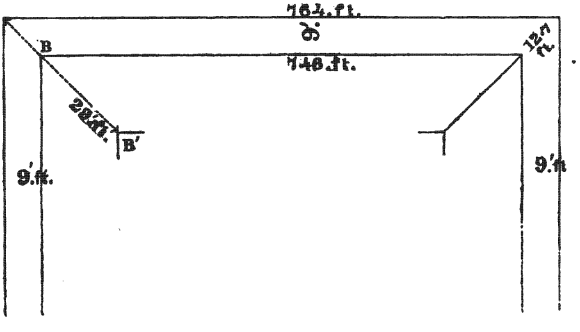
HENRY JAMES, Col. R.E.

On the day following the date of this communication, its author addressed the writer to a similar effect:—

SOUTHAMPTON, *24th November*, 1868.

MY DEAR SIR,

As regards the Great Pyramid—*having no theory to maintain**—I seek information and assistance from every quarter, to learn what was the unit of measure used in setting out the base of the Pyramid. I have lately had an opportunity of reading Perring's and Le Père's works, and if you can assist me in explaining what has perplexed me not a little, I shall feel much obliged—as an engineer yourself no one ought to be better able to do so.



According to Le Père's and Perring's measures, the length of the side as it now exists is 746 feet (we omit decimals here), and 764 feet the length of the finished Pyramid, and the distance between the angles of the sockets 9 feet, being according to Perring the breadth of the casing stones. This is quite plain and intelligible. But on the French *plan* of the Pyramid, the

* Now italicised by me—readers will be able to judge from the assertions which have been already examined, whether Sir Henry James had any theory to maintain or not, and on this point I may safely leave them to form their own opinion.—ST. J. V. D.

distance between the furthest corners of the sockets to the corners of the Pyramid as it exists is 29 feet instead of 12·7 feet, and Professor Smyth, from his "own measures" *at all four corners*, made the distance also 29 feet.

I do not understand this, and shall be glad if any one can explain it, for before it is explained it is clear we cannot understand the relative positions of the corners of the Pyramid to the sockets, or the construction of the works.

Yours truly,

(Signed) HENRY JAMES.

ST. JOHN V. DAY, Esq., C.E., &c.

Certainly these letters, at first sight, tend to make it appear that there are such numerous discrepancies between the measures referred to, that any attempt to reconcile them would be useless; but, on taking into consideration the state of the Pyramid corners, the discrepancies at once vanish. Accordingly the writer replied to Sir Henry James thus:—

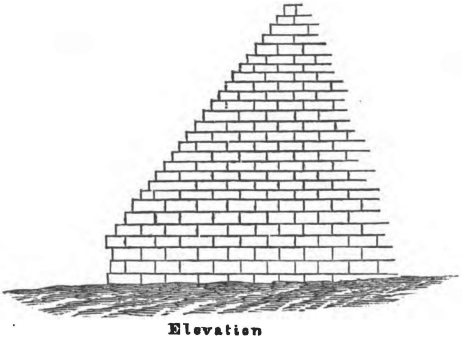
GLASGOW, *December* 9, 1868.

MY DEAR SIR,

I beg that you will pardon my delay in replying to your letter of the 24th ult. After reading that letter it became to me very clear as to what circumstances had misled you to the apparent discrepancies to which you draw my attention, and as you ask me to explain the difficulty I can only add with what readiness I do so.

Le Père and Perring give the distance from the side of the Pyramid, that is to say, from the bottom of the present flank to the lowermost outer edge of the casing stones or where they join the pavement, or half the difference of their dimensions of the present and original base length at 9 feet (here I avoid decimal exactitude, because Mr. Perring states his measures to the nearest inch only). Now these flanks, everywhere else except at the corners, have, ever since the time El Mamoun stripped off

the casing stones, been protected from deterioration—either by the mischievous breaking away of man or scaling off through the effects of climate (which in Egypt are comparatively little) —by the very thick overlying mass of rubbish; this accidental covering being comparatively small at the corners, and attaining its maximum at the centre of each flank. Not only then have the actual corners long been exposed, but by being so exposed, and from the mere fact of their being corners, I am sure I need scarcely explain to you as an engineer, that the stones at these corners were more easily removed than at any other part of the building; and the truth is, they are and have been removed more or less to the extent of 29 feet or thereabouts, as measured diagonally from the outer angle of the corner sockets. Any good photograph of the corners, of which there are several, shows them now to be abruptly or bluntly terminated, in place of continuing down to the platform at the original corner slope. Thus,



Elevation

On this point I refer you to page 133, Vol. II., also Plate 3, Vol. III., of "Life and Work." We see then, that in the measures of Le Père and Perring they supplied the defect of length due to the breaking away of the corners, whereas, the French plan gives 29 feet as the diagonal distance from the outer corners of the two sockets, which they saw, to the corners of the Pyramid, as it was in the days of the French Institute. The same or nearly the same length from the outer corners of the sockets to the present broken corners is deducible from Professor Smyth's measures; so that, on the whole, where the

conditions of each system of measures are truly taken into consideration, their comparative close agreement as *rough* measures of very rough and destroyed features is truly convincing.

If I have failed to make this quite clear to you, I beg you will acquaint me wherein you find still a difficulty, and I shall be glad to do my best to remove it.

You say in the first paragraph of your letter that you have *no* theory to maintain; my impression, from your letters to the *Athenæum*, was, that you had proposed three different theories: am I now to understand that these are abandoned *in toto?*

Yours very truly,

(Signed) ST. JOHN VINCENT DAY.

COL. SIR HENRY JAMES, R.E., &c.

To this letter Sir Henry James replied:—

ORDNANCE HOUSE,
SOUTHAMPTON, *December* 26, 1868.

MY DEAR SIR,

I have no theories respecting the Great Pyramid to abandon. I find the length of the side of the base to be $360 \times 25{\cdot}488$ inches, the length given for the derah by several writers. I also find that this length, as given by Inglis, is 500 Greek or Egyptian cubits; but Inglis differs in his measures from Perring and the French savans, and until we really know what the true length of the side is, it is hardly worth while to further discuss the subject.

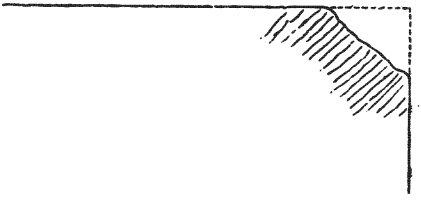
I have given directions for the party of surveyors I have sent to Mount Sinai to measure the Pyramid on their way home, if they have time for it.

Very truly yours,

(Signed) HENRY JAMES.

ST. JOHN VINCENT DAY, Esq., C.E., &c.

P.S.—Your explanation of the measures on the diagonals is probably correct.



This was the last letter received from the Ordnance Survey Director-General. The writer did not reply to it for reasons which must be obvious to any one who has taken the trouble to examine into the assertions and contradictions which Sir Henry James had made, determining rather to await the result of the Sinai surveyors' measure, since Sir Henry James evidently considered that to be the stronghold for data on which to carry out future investigations as to measures and geometry. The postcript shows that that gentleman was convinced by the explanation given him, in the writer's letter dated December 6th, of the apparent discrepancies which he had stated to exist between Le Père and Perring, the French and Piazzi Smyth's measures.

A certain alleged result of the Sinai surveyors' measures is now published, and we shall presently look into the inferences which have been drawn from them; but, before doing that, we cannot pass over certain incidents which occurred during the intervals between the date of this last letter and the publication of the said result.

Sir Henry James having to the writer privately

admitted the correctness of the explanation given to him, and therefore the fallacy of his own inferences, it was natural to expect that he would lose no time in declaring the discrepancy to be cleared up, in the same public manner as he had all along proclaimed his other assertions in the pages of a weekly journal. The writer had communicated the points of the correspondence to the Astronomer Royal for Scotland, who also looked out for a similar open and candid public confession; but weeks and months rolled on, the *Athenæum* pages not figuring with any further communication. At last, to ascertain the intent of this long silence, with the public calumny against the work of certain scientific gentlemen allowed to remain uninvestigated, my friend Professor Smyth wrote Sir Henry James:—

1 Hillside Crescent,
Edinburgh, 12*th March*, 1869.

Dear Sir Henry James,

In the *Athenæum* of November 28, 1868, you have charged upon the French savans, Col. Howard Vyse, Mr. Perring, and myself, an error, or "utterly irreconcileable discrepancy," of 16·5 feet in the length of the side of the base of the Great Pyramid.

My friend, Mr. St. John Vincent Day, C.E., pointed out to you soon after, that the error existed only in your own misapprehension of the real state of the case, a case fully and abundantly described in the volumes of my "Life and Work at the Great Pyramid."

May I ask if you have taken any steps, and what, to remove the aspersion which you so needlessly cast in the most public manner? and I remain,

Yours very truly,

(Signed) C. PIAZZI SMYTH.

To this the following reply was written:—

ORDNANCE SURVEY,
SOUTHAMPTON, 15*th March*, 1869.

MY DEAR SIR,

I have sent a letter to the *Athenæum*, stating that I had no desire to misrepresent you in my letter of the 28th November last, and that I regretted having fallen into the mistake I made in not seeing that the 16·5 feet of the masonry of the Pyramid had been removed at the corners, as well as the casing stones.

I hope this will prove satisfactory to you,

I remain, Yours truly,

(Signed) HENRY JAMES.

PROFESSOR PIAZZI SMYTH, Astronomer Royal, Scotland.

The letter referred to in that from Sir Henry James to the Astronomer Royal for Scotland is as follows:—

ORDNANCE SURVEY OFFICE,
SOUTHAMPTON, *March* 15, 1869.

I am anxious to be allowed to correct a statement which is contained in my letter which appeared in the *Athenæum* of the 28th November last, respecting the measures taken by Professor Smyth at the corners of the Great Pyramid.

From the frequent mention of the length of the side of this Pyramid, as it stands, to be 746 feet or thereabouts, and that with the casing stones the length must have been about 764 feet, it followed that 12·7 feet only had been removed at the corners, and I stated that the measure of about 16·5 feet more, making a total length removed from the corners of 29·2 feet, was irreconcileable with the above measures. I had no desire to misrepresent Professor Smyth, and I regret that I had inadvertently fallen into this error, as it appears that this 16·5 feet of masonry of the Pyramid has also been removed at the corners.

The chief point of interest connected with the dimensions of this Pyramid lies in the fact that, having the corners of the sockets for all four corners of the Pyramid perfectly preserved in the rock in which they are cut, we have the data for ascertaining the length of the common Egyptian cubit at the time the Pyramid was built;

in the same manner that we have obtained the length of the Greek foot and cubit from the measures of the Parthenon. Mr. Inglis, a practical engineer, measured the distance from corner to corner of the sockets, and found the lengths of the sides to be 9120, 9114, 9102, 9102 inches, the mean being 9110 inches. Stuart obtained 12·138 inches as the length of the Greek foot from the measures of the Parthenon, and Penrose 12·16 from them, the mean length of the two being 12·149, and the mean cubit, therefore, 18·224 inches, which, multiplied by 500, gives 9112 inches, differing only 2 inches from Inglis' mean measure. If we take Stuart's length of the Greek cubit 500 times, its length only differs 1½ inches from Inglis' length of two of the sides, being 9102 inches; and if we take Penrose's length of the Greek cubit, it gives us exactly 9120 inches—Inglis' largest measure.

These results appear to me to demonstrate that, as Herodotus has stated, the Egyptian cubit was equal to that of Samos, that is, to the Greek cubit; and that the sides of the Great Pyramid were made exactly 500 Egyptian or Greek cubits, and that the Pyramid covered exactly 25 aruræ or Egyptian acres; the arura, according to Herodotus, being a square of 100 cubits.

The height of the Pyramid was determined, as I have said before, by giving the structure a rise of 9 in 10 at the corners.

(Signed) HENRY JAMES, Col. R.E.

As the assertions in this letter are repeated in a subsequent publication, they are for the present passed over until reached in the order in which they occur to be examined in the next part of this criticism.

III.—In the preface to "Notes on the Great Pyramid of Egypt,"* the author states, "My chief object in writing these short 'Notes' has been to

* "Notes on the Great Pyramid of Egypt, and the Cubits used in its Design." By Colonel Sir Henry James, R.E., F.R.S., Director-General of the Ordnance Survey. Southampton: Gutch & Co. 1869.

obtain a knowledge of the true lengths of the units of measure employed in setting out the external and internal dimensions of this Pyramid; or, in other words, to recover, if possible, the true lengths of the cubits in use upwards of 4000 years ago." The investigations instituted for the purpose above stated are detailed in eight notes and addenda, which the writer now proposes to review, in order to estimate the degree of reliability attaching to the results stated as being thenceforth educed.

(a.)—"On the length of the *common cubit* of Egypt *which was employed* in setting out the external dimensions of the Great Pyramid."

The reader will not fail to observe the assertion (in the title of the first note immediately preceding), to make which prominent the writer has in part italicised. In order that an assertion may be accepted as infallible it must be proved, and the author of the "Notes" appends what he professes to be a proof, in which he states that Herodotus tells us "the Egyptian cubit *is* equal to that of Samos," that is, to the "Greek cubit." Reasoning for the present *apart* from further enquiry as to what the true interpretation of the Herodotean passage is, it does not appear absolutely impossible that a nation (the Greek) rising into prominence and overrunning Egypt 1700 years after the completion of the Pyramid, may have found a measure in use there equal or nearly equal to some linear unit of their own, but it is highly improbable; and, when we consider the dif-

ference in length of the two cubits (even allowing for the moment Sir Henry James' length of the Greek cubit, viz., 18·2415 British inches, and placing against it the cubit of Memphis of 20·70 inches), we see so large a difference, impossible to account for, especially when we know the cubit was so religiously guarded a thing, even in Pantheistic Old Egypt; and it is, indeed, far more likely that they (the Greeks) at that period brought away the cubit then in use in their own country and endeavoured to introduce it into Egypt. Yet the mere granting or refusal to admit either of the foregoing suppositions is immaterial, for it may be asked, although it really was the fact that the lengths of the said alleged cubits agreed at the time Herodotus wrote, does that alleged coincidence at that particular period prove that the Pyramid was built according to the selfsame cubit? or even that a cubit approximately of the same length as the Greek cubit was ever known in Egypt at the time of building the Pyramid? or does it show that the length of a cubit had remained unaltered through the said 1700 years? Further, supposing that a cubit really had been found in Egypt by the Greeks of a length equal to their own cubit, is the mere *literary* statement of Herodotus to be held as an index of the precision with which the Greeks when in Egypt compared the two alleged cubits? Have we any precedent for warranting us in giving the Greeks credit for possessing instrumental means for making such a comparison for the identity of two units of length? a comparison, indeed,

to conduct which with positive accuracy would baffle the skill and refinement of the most renowned instrument makers and users of this nineteenth century. It is too well known a fact by everyone versed in refined measurements, that they cannot be made with that positive accuracy attending the statements of dimensions in the assertive character of the "Notes," throughout which there is no allowance for even an almost vanishing value of $\pm x$. Whilst, again, if we are to infer anything from Greek architecture—that is to say, of its mere *structural* quality—alas, how altogether second-rate is it when placed in the face of that transcending masonry of the oldest built monument of Egypt!!

It is barely necessary to remind the reader that the writer is speaking here quite regardless of architectural styles, having only to do with the excellence of mechanical construction as touching metrological conditions and data. The author of the "Notes" evidently feels satisfied with answering the above questions in the affirmative, for he says, "In the Hecatompedon of the Parthenon, at Athens (*so called because the platform on which the columns stand was made a double square of exactly** 100 *feet*), we have preserved the length of 100 Greek feet at the time this Temple† was built, viz., about 440 B.C.;" and in support of this he cites the measures thereof made by Mr. Penrose, thus—"From the measures

* The italics are mine.—ST. J. V. D.

† If it could be shown that a purpose of the Hecatompedon had been to preserve certain lineal measures, then no one could misinterpret the passage.—ST. J. V. D.

of Penrose, *taken with the greatest care,** see his letter from Athens of the 8th Nov., 1846, addressed to the Society of Dilettanti."

Yet after all the foregoing, it still has to be asked, What did Herodotus mean when he wrote, Euterpe, 168, "the Egyptian cubit is equal to that of Samos?" Sir Henry James asserts he meant to convey to posterity that the Egyptian and Grecian cubits were equal. Yet, during the time that the present criticism has been written, the true signification of the Halicarnassian's words have been closely investigated by the Astronomer-Royal for Scotland, and published, with the after-mentioned result, in a report to the Edinburgh Royal Observatory Board, dated June 29, 1870. The passage wherein the quotation from which Sir Henry James has inferred so unwarrantable a conclusion, runs thus in Professor Rawlinson's translation :—

"The warrior class in Egypt had certain privileges in which none of the rest of the Egyptians participated, except the priests. In the first place, each man had 12 aruræ of land assigned to him free from tax. The arura is a square of a hundred Egyptian cubits (*the Egyptian cubit being of the same length as the Samian*). All the warrior class enjoyed this privilege together; but there were other advantages which came to each in rotation, the same man never obtaining them twice."

And regarding which the said Astronomer-Royal remarks:—

"If we turn to his (Herodotus) book, Thalia, 55, he makes a Lacædemonian speak of the Samians (in their isle so very close

* The italics are mine.—St. J. V. D.

to Asia Minor, and so far from Greece) as 'foreigners;' and in Thalia, 56, he himself characteristically speaks of a siege of Samos by the Lacædemonian Dorians as 'their first expedition into *Asia*.' 'Words,' says the Rev. Professor Rawlinson, 'which are emphatic. They mark the place which the expedition occupies in the mind of Herodotus. It is an aggression of the Greeks upon *Asia*, and, therefore, a passage in the history of the great quarrel between Persia and Greece, for all Asia is the king's.' (i. 4.)

"'Samian,' then, in the mind of Herodotus, meant *not* 'Grecian,' but the antipodes of Grecian, namely, Persian and Asiatic; and when *he* said there, Euterpe, 168, that the Egyptian was of the same length as the Samian cubit, he meant to instruct his Athenian audience that the Egyptian soldier's favoured plot of ground was measured out by a *bigger* cubit than their Greek one, viz., by one of no less than 20·6 or 20·7 inches long, nearly; this having been found in modern times to be the length of the ancient Persian, Babylonian, and other Asiatic cubits about the epoch 600 B.C. to 450 B.C., as well as of the Egyptian."*

With regard to the Hecatompedon, the statement which Sir Henry James has made is truly astounding. He says it is so called because it is "*a double square of exactly* 100 *feet*," and endeavours to support his assertion by the measures of Mr. Penrose. But what do these said measures really disclose when appealed to, in their one and only full and complete publication, viz., his (Mr. Penrose's) in the Dilettanti Society's magnificent volume on "The Principles of Athenian Architecture," published in 1851? Why, this, that the Hecatompedon is *not* a double square at all, or even anywhere near that proportion!!

Its breadth, according to Penrose, is 101·336 British feet; and if a double square, it should be

* *Vide* Appendix, "On Cubits."

British Feet

$$101{\cdot}336 \times 2 = 202{\cdot}672$$

in length; but it is not so. Mr. Penrose's measures are, for the length,

228·141 feet,

or no less than 25·469 feet too long for the double square proportion, stated by Sir Henry James to be *exact!*

Then, as regards the word "Hecatompedon," the writer finds it impossible to conclude this particular part of the Parthenon having been exclusively so called because of one dimension (the breadth) being approximately 100 Greek feet; and from Mr. Penrose's own book we learn that the "Hecatompedon" is generally believed to have been an old name of the Parthenon; modern enquiry, based upon the mere word itself, and upon one only of the literal construings of said word, having tried to find out where the 100 feet were expressed, and how, whether in horizontal length, vertical height, or square measure. But as the word "Hecatompedon" is sometimes supposed to be built up of two Greek words, εκατον (a hundred) and πους (a foot), the latter word signifying both a foot of measure, and just as often a foot, pedestal, platform, base, &c., how are we to decide whether or not, in this Parthenon case, it was so called as being the platform or area, or that the temple was built on the site of a platform or area whereon the hecatombs were sacrificed, and, therefore, made up of εκατομβη (the

sacrifice of a hundred beasts) and πους, the platform or area whereon the sacrifice was offered to Zeus, or Neptune, or Apollo, or any other of the Olympic band of deties? Philologically, either of the inferences is as probable as the other, and the *sacrificial* a much more suitable derivation than the *metrological*, for the name of a temple known otherwise as intended for worship, votive offerings, and not for metrological science; and when we now really do find, on examining the true state of the case, that the platform on which the columns of the present Parthenon ruin stand is not and never could (in that building) have been a double square of 100 feet, the probabilities even lie with an increased weight in favour of the second radical deduction, namely, the "sacrificial." The latter view, indeed, receives additional support from those authors who say that "Hecatompedon" was the name of an older temple, destroyed by Xerxes, on whose site the Parthenon really was built in after times. While the modern authorities for the real value of the Greek foot in terms of British feet vary, according to the most recent and learned authority, Dr. J. Brandis, of Berlin, in 1867, so much as from 103·35 to 101·05 British feet for 100 Greek feet; whence Mr. Penrose's measure of the breadth of one of the three Parthenon steps as = 101·336, may, according to the authority considered most worthy, actually disprove itself from having been ever intended by the Greeks to represent 100 of their feet exactly and perfectly to all posterity.

Again, the length of the Greek foot, says Sir

Henry James, without any doubt in his mind, was equal to 12·1610 inches, to which adding half the length of the foot, 6·0805 inches, we have the length of the Greek cubit, equal to 18·2415 British inches. Doubtless Mr. Penrose took his measures with the greatest care, that is to say, with all that care and skill in accurate admeasurements that he could bring to bear, but has Sir Henry James used or even examined them with equal care? What about inevitable instrumental errors, of which he (Sir Henry James) takes no notice, and even misrepresents the measure themselves, for he adds, "*If the assertion of Herodotus be correct*, this must have been also the length of the Egyptian cubit *at the time he wrote.*" Here, then, we find that some doubt as to the veracity of Herodotus is raised, and a query is admitted though not stated, that if the Greek and Egyptian cubits did correspond when Herodotus wrote, or in 443 B.C. nearly, whether such alleged cubit did correspond to the cubit of Egypt or Memphis in the year 2170 B.C. The reader will not fail to observe that the passages last italicised rest on the measures and Parthenon theories of Mr. Penrose only, excluding Dr. Brandis's other and independent authorities, and on the statement of Herodotus; yet, whilst the language used admits of the possibility of some uncertainty, nevertheless, in the very next line, Sir Henry James adds, "*This** *was* also *the precise length* of the Egyptian cubit at the time the *Great Pyramid was built.*" Unfortu-

* Namely—18·2415 inches.

nately for our cause, Herodotus is dead, and we are thus deprived of the benefit of cross-examining him, and asking him whether he ever said, or meant to say, what has just been quoted above for the time and intentions of the Great Pyramid builders. Mr. Penrose, however, lives, and may therefore be appealed to; nay, rather, he has considerately saved the necessity for that course, to some extent, by voluntarily coming forward at this present time with his own comments on his own measures, and here we are fortunate, through the kindness of the Scottish Astronomer Royal, in being able to insert Mr. Penrose's unsolicited testimony :—

ST. PAUL'S CHAPTER HOUSE, E.C.
November 1, 1869.

DEAR SMYTH,

Thank you for the paper (Appendix C*) on the Great Pyramid I received to-day, I have not taken any stand one way or the other in the question referred to in it. Col. Sir Henry James kindly sent me his pamphlet in which the subject was mentioned, and I found that my measurements were quoted, and as these were *not the finally concluded results*, but taken from a statement made by me in progress of my examination, I thought it best to send him what I thought was a correction, though a minute one.

If he has "cooked" the Pyramid measurements, the agreement which I saw in them would not apply. I merely wish you to understand that I am not a partizan, but wished to contribute my mite without a blur on it.

Yours truly,

(Signed) F. C. PENROSE.

* "Appendix C" is one of the appendices to a statement by Professor P. Smyth to a Committee of the Royal Society of Edinburgh, November 15, 1869, which appendix consisted of two letters published in the *Daily Review*, one by Sir Henry James, October 9, the other by Professor Smyth, October 22, 1869.

With regard to this letter, and one to Sir Henry James, the notable feature is, that whilst its writer did not hesitate to correct Sir Henry James on his error of a minute portion of the foot, he omitted altogether to notice the double-square ratio blunder which has been above considered.

(β).—We now arrive at Note second, "Dimensions of the Base of the Great Pyramid."

In this Note it is stated, "The mean length of the sides (*i.e.* of the base) obtained by the Ordnance Surveyors was 9,130 inches. The mean of these two results (*i.e.* of Messrs. Aiton, Inglis, Smyth, and Ordnance Surveyors' measures) is 9,120 inches, and it is remarkable that one of the measures of Mr. Inglis is exactly 9,120, and of one of the Ordnance Surveyors' 9,121 inches.

"We may, therefore, confidently regard 9,120 inches or 760 feet as the *true* length of the side of the Pyramid when it stood perfect."

Now it must be asked, in regard to the last quotation, why has Sir Henry James suppressed every other measure which the Sinai Survey party are alleged to have made, except an alleged mean of all their alleged measures and a certain one of 9,121 inches? If 9,130 inches really be the mean of all their measures, it is quite clear that there must be as many measures on the *plus* side of 9,130 approaching to the limit of 9,140, as there are on the *minus* side approaching to the limit of 9,120, in order that such a mean value may result. How

far then does the limit of 9,140 differ from Piazzi Smyth's concluded mean of 9,142 inches? By two inches simply! Yet why does Sir Henry James altogether discard the splendid measures of the French Academicians, whose work he extols in his preface as "the most perfect work yet written," and the Vyse–Perring measures of some thirty-three years ago, both made at a time when the Pyramid was in a far superior state for measurement than it is now-a-days, or ever can be again until the rubbish heaps are cleared away? Measures, therefore, if not more reliable, at least entitled to quite as much respect as those made at any time since, and which, as shown in the tables at page 11, are 9,168 and 9,163·44 British inches respectively; their closeness of approach to equality, independently of the care and tranquil spirit in which they were made, indeed, afford great weight for a considerable amount of reliance to be placed upon them. Why the author of the "Notes" has not used them nor Piazzi Smyth's finally concluded mean of all the measures is clear enough: they would not submit to the cooking process necessary for producing a mean length on paper to accord to his 18·2415 cubit theory; or that the true length of the Pyramid base side = 18·2415 inches × 500.

But to proceed to the next passage (page 8), "We may, therefore, confidently regard 9,120 inches or 760 feet *as the true length* of the side of the Pyramid when it stood perfect. But 9,120 inches is *precisely equal* to 500 Egyptian or Greek cubits

of 18·2415 inches." This much for the assertion. The fact, however, is, that anyone who will ascertain the product of 18·2415 × 500 will find that it is *not* precisely 9,120 inches. Nevertheless, the modern military author proceeds to assert that these (viz., the trio of a mistaken length of Penrose's Greek foot, a tampered with and adulterated statement of the measured length of the Great Pyramid's base side, and a fancy number of his own) verify the conjecture of Sir Isaac Newton, "that the base was made a round number of Egyptian cubits;" he, Sir Isaac Newton, believing at the time that the Egyptian cubit was of a totally different length to that invented by Sir Henry James, and never having heard of the Pyramid's base sockets, nor the π angle of its sides. But the truth cannot long in any case remain hid. Mr. Penrose, upon whose measures of the Hecatompedon Sir Henry James has based his assertions, has, as we have seen, voluntarily come forward and virtually accused him, first, of being sadly behind the time in the literature of his own subject, in that he has based his theory on a mere preliminary notice of his, Mr. Penrose's, measures, and not on his full statement contained in his grand work, "The Principles of Athenian Architecture," published so long ago to all the reading world as 1851; and, secondly, of not having yet freed himself from the charge of cooking the Pyramid's published measures to make them suit his last theory. After all this extraordinary procedure, too, in what ought to be a scientific discus-

sion, it turns out that even yet the theory and the facts do not fit each other. Nay, worse still; after the Pyramid's base-side measures have been secretly "cooked" to make them suit a certain supposed true value of the Greek foot, it has been announced, and by the very authority depended on, that that was not the true value; and further, that the whole excuse for lugging in that Greek foot to explain Egyptian facts of 1700 years earlier, is based on a total mistake in reading a comparatively modern Greek author.

(γ)—Note 3 is on the "Proportions of the Great Pyramid," and Note 4 on the "Profiles for the Construction of the Great Pyramid." In substance these two Notes are a mere repetition, with, perhaps, a few more errors, of what was published in the *Athenæum* of November 9, 1867, still, as the writer has examined these statements before in the early part of these pages, it is unnecessary to repeat what has been already said; therefore, he passes on to the next, Note 5, "On the cubits with which the interior dimensions of the Pyramid were set out."

(δ) "*Cubit of Memphis.*"

This note begins by a quotation from Sir Isaac Newton's "Dissertation on Cubits," in which Newton deduces his result from the measures of Greaves (the best measures to which Newton had access), that the length and breadth of the King's Chamber

was in conformity with a cubit which Newton thought fit to call the "cubit of Memphis," the value of which, at the time Newton wrote, was given by him at 1·719 English feet = 20·628 inches; but Newton significantly comments on his own work thus, "Those who shall hereafter examine *the Pyramid*, by measuring and comparing together with great accuracy more dimensions of the stones in it, will be able to determine with greater exactness the true measure of the cubit of Memphis." Immediately after which (the foregoing passage being even quoted in the "Notes") Sir Henry James adds, "The measures since taken prove how close was the above length to the true length of the cubit of Memphis, for since the time of Newton several ancient cubits have been found, one of which, found at Karnak, is now in the British Musuem, the length of which I myself very carefully measured, and found to be 41·398 inches." Thus it is even presumed to compare a wretched scale of perishable wood (brought, too, from a city very distant from, and far more modern than, the ancient Memphis), lying now in the British Museum and damp atmosphere of London, and set it up by itself (without any regard to the other similar scales in many other Museums both in Britain and on the Continent) as a compeer and corroborator of Sir Isaac's Newton's sagacious inference and suggestions as to further Pyramid measurements on the lasting and veritable *stones* thereof. That great philosopher, however, never did suggest that his inference, taken as it was from the Great

Pyramid, was ever to be verified by reference to easily handled, easily altering, wooden copies of metrical units found haphazard, and because left accidentally by some careless working mason,* amongst ruins in rival and even antagonistic cities at great and variable distances from Memphis, and of a date not less than 1200 years subsequent to the zenith of Memphis. No, but he did say that the dimensions of the *very stones* of the identical Great Pyramid itself were to be determined with greater accuracy, in order to educe the true measure of the cubit of Memphis. Does Sir Henry James then suppose, that after he has found no one to extol his measures of the not so old bit of wood in London but himself, that modern research will condescend to place it side by side with Newton's suggestion, especially when the very measures which Newton really did suggest should be made, have now been made, by the French Institute—the Perring-Vyse measures—but, more than all, Piazzi Smyth's, none of which are even hinted at in the Notes. Does he suppose that scientific men will listen to such a mockery and delusion? The British Museum double or royal cubit might be allowed a place, as confirming to some extent the approximate length of the cubit of Memphis; but most certainly (in fair scientific comparison) it cannot be viewed in any light of approximation but as being the

* This is no mere figure of speech, but the positive conclusion drawn from the circumstances under which that cubit of the British Museum was found a few years ago, on pulling down the masonry of a pylon tower at Karnak.

child or offspring of the grand and ancient standard in stone, locked up immovable and unattackable by weather or degradation of men, in the unequalled granite masonry of the King's Chamber, as shown by Newton nearly two centuries ago. Yet why does the author of the "Notes" ever speak at all about his own particular measure of the Theban double cubit, from which his 20·699 inch Memphite cubit is deduced, when, from the measures of Greaves, Newton's deductions therefrom, those of the French and Sir Gardner Wilkinson, or from a far wider range of testimony both in wooden cubits and monumental buildings, Piazzi Smyth had previously deduced 20·70 inches as a mean, had published it even so far back as 1864, and had also shown that several specimens of the said cubit varied between 20·6 and 20·8 inches, and more recently had set forth his inferences from many of his own measures in the Great Pyramid, and on more numerous features of it than have been examined by any one else, that the mean Pyramid quantity is 20·72 inches. When these other measures and specimens of the cubit, at least as good as the British Museum bit of wood, give values for its length varying from 20·6 to 20·8; and when the 20·7 approximation is confirmed, within a much smaller quantity, by the Pyramid exactly in the manner Sir Isaac Newton directed, it may be asked, Is any more truth to be expected out of one, and one cubit only, which gives—if, indeed, that is true for all or what temperatures and all or what moistures of the London climate—20·699 inches?

Even the long tail of decimals, itself a most awkward condition of this particular length, looks suspicious of a desire to impress the public that in this case so much more real accuracy has been gained, so much more lasting a material for an ancient standard, and so much better an authenticated copy of a *bonâ fide* Memphis standard have been met with—that all future Egyptologists desiring the length of the Memphis cubit may entirely discharge Greaves, Newton, Jomard, Gardner Wilkinson, Howard, Vyse, and Piazzi Smyth from their memories, and quote only Sir Henry James, who has only measured one of the many wooden cubits found in Egypt, and that one not the most likely to give a true idea of the Memphis one, either ancient or modern. But it has recently been well remarked to me, by a laborious worker in Pyramid research, "What could you not prove by three different things if you are allowed to invent each of them, and are not required to show parallel proof from independent history!"

(ε) With respect to Note 6, it may be passed over by the mere comment that a similar order of assertion unconfirmed by fact characterises it also; and that Sir Isaac Newton's inference of the length of the sacred cubit, drawn from the data which he possessed, is assumed as a *final* and *settled* quantity, and so made use of to support the Royal Engineers' chief's notorious procedure in regard to the old bit of wood at the British Museum, notwithstanding that Newton himself pointed out, as above explained,

that this length of 24·83 British inches, although a result of his investigations, was by no means considered by him as an ultimate settlement of its length.

(z) We pass on to Note 7. "The cubits of the Nilometer at Cairo." In connexion with this Note, the reader is referred to fig. 3, Plate V. (reproduced in the Plate at the end of this criticism), in regard to the lengths of the said Mohammedan Nilometer cubits. The Note sets forth that "the lengths of the cubits leave no doubt but that they were intended for the cubits of Memphis, the measured lengths of the three upper cubits being 21·10, 21·12, and 20·56 inches respectively." Nevertheless, on the Plate these said cubits are marked in plain figures 20·699 inches accurately. How, then, can the text and Plate be reconciled? In truth, they cannot be. Yet further, by what species of magic can such numbers 21·10, 21·12, and 20·56 indicate that 20·699 was intended, and that so distinctly as to "leave no doubt" about it, even when, several years ago, Sir Gardner Wilkinson, when pursuing his investigations in a truly philosophic spirit, had pointed out that the length of the cubits on the self-same Nilometer was 21·2 inches nearly. It is, however, stated that one of the three measured cubits is as little as 20·56 inches, but which of them is of this peculiar length we fail to discover—whether the top, middle, or bottom one, neither Plate V. or the photo-zincograph frontispiece afford the least clue, for the top of the shaft does not even appear in the

latter, but a portion only at some uncertain distance down the stone shaft; and of what use said photo-zincograph is, but to make confusion worse confounded, it is well nigh impossible to appreciate, for no instructions are given throughout the "Notes" as to ascertaining from it the lengths of those cubits which it does show; and nowadays, when, in astronomy, angular measure from photographs is a practical attainment, the least that any one would expect to find in a treatise professedly designed to set forth the *real state* of the case on certain disputed metrological questions, are the limiting values of the angle of subtense of the camera while the picture was taken—by knowing which the ascertainment of the lengths of the cubits, within certain narrow limits of error, would be an easy affair of practical trigonometry.

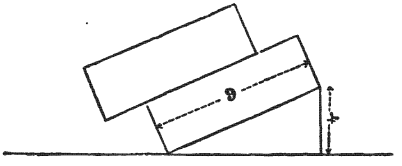
It is not mentioned, either, that the Nilometer once had a gilded capital of the Corinthian order; and as no explanation of one extraordinarily anomalous cubit is given, it can but be inferred, until further insight is afforded us, that this 20·56 inch length is the top cubit, if it really be any one of the number, on the stone shaft, and its shortness due in some measure, or perhaps entirely, to the removal of the crowning capital.

(η)—The last, the longest and concluding, Note 8 is now reached. Its title is, "Angle of inclination of the descending entrance passage and of the ascending passage from it to the Grand Gallery;" and it commences by stating that "the architect has, with

great judgment and foresight, made the inclination of the two passages equal, and made them a little under *the* 'angle of rest or quiescence,' or a little over 26°. At *this angle anything* (*sic*) *could be made to slide down them with great ease,* but without too much precipitancy at first, and therefore easily controlled."

The foregoing passage speaks of "the angle of rest" as if it were one particular angle common to all substances alike, for it is said at this angle "anything could be made to slide down them—*i.e.*, the passages—with great ease;" whereas it is well known, from the experiments of Morin, and others, that the "angle of rest" is a most varying quantity among the numerous substances composing the material world. But it is even untrue to say that the said angle of passages (26° nearly) is by any approximation even an angle at which any smooth and comparatively solid substances repose; nay, the angle for dry bricks alone, according to Morin's experiments, is from 31° to 35°, and for the stone of the Pyramid passages—limestone—near 18° to 20°; and Piazzi Smyth, when at the Pyramid, had great trouble in preventing his measuring bars, and other instruments, from rushing away with violence down the steep smooth surfaces of the very passages alluded to. How, then, can any one assert that "at this angle anything could be made to slide down with great ease?" Yet even this false assertion is crowned by the following trick with *fire-bricks*:—"If any schoolboy would tilt up a fire-brick 4 inches in the way he

would for catching sparrows, the upper surface of the brick will then have the inclination of the passages into the Pyramid. The brick being 9 inches long and one end raised 4 inches, we have $\frac{4}{9} = \cdot 444 =$ sine of 26° 23′, the angle of slope. Then, if he puts another brick on the inclined one (see woodcut), he



will see that the brick will just rest on it, but will slide down on giving it a very gentle tap; *proving that for materials such as the bricks are made of, and for the stone of which the Pyramid is built, this is the 'angle of rest,' and he will have a practical illustration of the reason why the builder of the Pyramid adopted this angle of inclination for the passages.*" So that Sir Henry James infers that because a brick —not a common red wall-brick, but, lo, a *fire-brick!*— is found by him not to slide on its neighbour when placed as in the annexed woodcut, therefore the *stones* of which the Pyramid is built will not slide under a like position. The writer presumes from the statement that Sir Henry James has made the experiment; but why a fire-brick was used it is difficult to conceive. Why was not the experiment tried also with common building bricks, for the angle of repose is not so much a question of the clay of which the

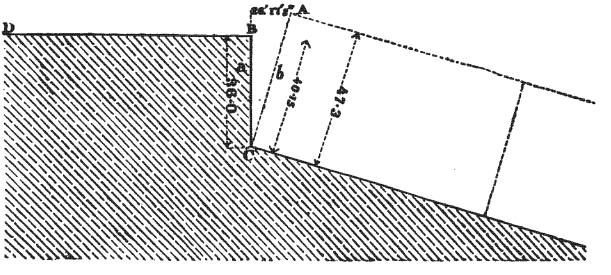
bricks are composed, as it is a question of comparative smoothness or roughness of the surfaces brought in contact, as well as of specific gravity. Possibly the specific gravity of the fire-brick is a closer approximation to that of the stone of which the Pyramid is *built;* but then the stone of the passages and the stone of the portcullis or block which has been slid down the ascending passage is a different stone altogether from that of which the structure is *built,* or mainly consists. The Pyramid is *built* chiefly of nummulite limestone, with rough and uneven surfaces—the very stone of the hill on which it stands; the portcullis is granite; and the passage limestone, both finished to very smooth and level surfaces. How then, could any one be so amazingly misled as to conclude that, because a miserable rough-skinned fire-brick will not slip on another at an angle of 26° 23′, that huge blocks of *polished* granite will not slide on equally polished limestone surfaces inclined at the same angle. Alas! alas! for the sagacity of the school-boy "catching sparrows" who cannot see through "such like absurdities as these."*

The Note 8 proceeds further to say that "the step up into the antechamber of the King's Chamber is made of such a height that, when the blocks of the plug lay in the Grand Gallery, *the upper edge of the topmost block was on a level with the floor* of the antechamber." Now, let us see how far this assumption, carrying with it, too, a claim to have discovered

* Preface to the "Notes" under examination, page 4, lines 3 and 2 from bottom of page.

a veritable mental intention of the original architect, accords with the measured facts.

Demonstration of the Error of Sir Henry James' asserted equality.—"The step up into the antechamber of the King's Chamber is made of such a height that, when the blocks of the plug lay in the Grand Gallery, the upper edge of the topmost block was on a level with the floor of the antechamber."



Here—

a = the step up into the antechamber;

B D = antechamber's floor, all on one level, excepting one stone in the middle, slightly risen;

b = upper sides of topmost port-cullis block, brought up from below to suit Sir Henry James' theory, and placed where it never could have been, seeing that there were other stones above it.

Now in the triangle A B C, Sir H. James asserts that the points B and A were *made* to be on the same level, and were so. Let us test it—

a is vertical, and 36·0 inches high (see p. 74, vol. ii., "Life and Work");

$\angle$ C = 26° 17′ 3″ (see also p. 158, vol. ii.);

Wherefore, in the Δ, right-angled at B, the side b = 40·15 inches.

But what is the length of *b*, as measured on the portcullis blocks?

The true length of *b* is there 47·3 inches (see p. 52, also p. 51, vol. ii., "Life and Work");
∴ The difference in *length* computed, and found = 7·15 inches, which reduced for the angle C to *height* = 6·41 inches, or more than $\frac{1}{8}$ of the whole,

which is the error of Sir H. James' very confident assertion of what the builders made with an intention of equality. The probable error of any of the measurements is less than 0·1 inch.

The Note next proceeds with a further elaboration of the wheel and pulley transport contrivance, which, to be brief, it suffices to say is too absurd to dwell upon.

On page 13 there occurs the unsupported assertion that, after King Cheops' body had remained hid in the Pyramid for 2960 years, the Pyramid was in A.D. 830 ruthlessly forced open by the Khalif Al Mamoun, and that the King's body was "thrown out and treated with grossest indignities by the rabble of the streets of Cairo."

The writer has, with much pains, examined and previously published extracts from what is known or written regarding the alleged burial of Cheops in the Pyramid*; and the evidence which has been collected shows that Cheops never was buried therein, so that where Sir Henry James obtained the information from, given above, and how he ascertained its absolute verity, to the exclusion of all other well

* Trans. Phil. Soc., Glasgow. Vol. vi. 1868.

known and long published details, it is beyond the writer's power to imagine.

The contraventions of what is known are indeed something fearfully numerous in this one short quoted passage: for if the reader will turn to the admirable compendium of Arab authors by Dr. Sprenger (in Col. Vyse's celebrated 2nd vol. of his "Pyramids of Gizeh"), he will find that the *majority* of those medieval historians declare that no body, corpse, or mummy at all was found inside the Pyramid by Al Mamoun, and *none* of them mention such a body having been "treated with the grossest indignities by the rabble of the streets of Cairo." That is indeed quite new.

Even, however, if there had been such a body found in the Pyramid, and afterwards kicked about in Cairo, there are two most potent reasons assignable by modern Egyptology why such body could not have been that of Cheops, viz. :—

1st, That no lasting method of embalming had been invented in that day; the efficient natron of Theban times had not come into use, and in its place only sweet spices were employed; fragrant perhaps for a time, but so little lasting as to have allowed all the mummies of the earlier Egyptian dynasties to dissolve into black humid matter, of which, indeed, Col. Howard Vyse found much in the blue basalt sarcophagus of Mycerinus, when he opened the burial chamber of the third Pyramid. (See Osburn's "Monumental History of Egypt;" also Vyse's "Pyramids of Gizeh.") And,

2nd, That the Great Pyramid was entered, maltreated, and ruthlessly spoiled about fifteen hundred years after it was built by the ancient Egyptians themselves, who at that time had become fanatics of a changed religion.

These are surely pretty powerful objections against Al Mamoun, after another long interval of fifteen hundred years, having found the body of Cheops himself in the Pyramid, and in so perfect and tough a state, that it could be conveyed six miles across the country into Cairo, and then given over to the rabble there to treat with studied indignity. But there is still further to be disposed of, the clear and uncompromising statement of Herodotus—who lived thirteen hundred years before Al Mamoun, and is the earliest author on the Pyramid known—to the effect that Cheops positively and actually was *not* buried in any part of the Great Pyramid, but in a certain subterranean chamber, cut in the rock and surrounded by the waters of the Nile.

Now, such a chamber—and with it Cheop's body, according to Herodotus—has never yet been discovered, either in, under, or near the Great Pyramid; unless, indeed, a certain recent author, Carl von Rikert, in his "Menes and Cheops identified in History," published only this present year, may perchance be right in recognizing the long sought apartment in the so-called Campbell's Tomb of Vyse, to the south-east of the Pyramid. Certainly it presents there a square Cyclopean pit, deep cut into the solid rock, and succeeded by a yet deeper fosse, simi-

larly hewed, and reaching down very nearly, if not quite, to the Nile level; in a region, too, where Nile water does soak through the sub-stratum. But even supposing that that is the at last discovered tomb of Cheops, while it is by no means inside, but rather about a quarter of a mile outside, the Pyramid, its original contents had been utterly taken out and made away with in the time of the 26th dynasty, and their place supplied with natron-preserved mummies of the men of that very late age of ancient Egypt, about 600 B.C.

Who, therefore, can avoid concluding otherwise than that the apparently, or would be, historical sentence on p. 13 of Sir Henry James' remarkable "Notes" must have been written on pure guess and venture, except that it contrives to oppose itself with such curious pertinacity to almost every single and individual fact that is known with regard to Cheops, Egypt, Egyptology, and history.

After this Note, certain *addenda* follow, of a most fanciful nature, too; and not the least astonishing statement therein is that with which the addenda commence, viz. this, that "the second and third Pyramids had the same proportions as the first or Great Pyramid." If the proportions were the same, it is abundantly clear that the angles of the faces of each would be all equal; but, after allowing fully for instrumental errors in the observations, they are as follows, the best results of measure and chief competing theories for the Great Pyramid, differing by a few seconds only, and the builders having been

proved to be able to build true to one minute of angle :—

	Angle rise of sides with the horizon.
Great Pyramid, ...	= 51° 51′
Second "	= 52° 20′
Third "	= 51° 00′

In now announcing that he has concluded the criticism, the writer cannot but deeply regret that he has most reluctantly been drawn into it, partly as the result of many years study in penetrating the wondrous storehouse of knowledge enshrined in the primeval monument of the oldest ages of the old world; but chiefly through the attempt which has been made by the Director-General of the Ordnance Survey to set aside the researches of Greaves, the inferences therefrom of Newton, the investigations of the French Napoleonic savans, the labours of Vyse and Perring, the investigations based thereon of Herschel, and, still more, to subvert the latest, most laborious researches made at the Pyramid by the Scottish Astronomer-Royal. It is in the cause of primeval truth only that the unwelcome duty has been fulfilled; and the writer can but add, that, conscious as he is of great and numerous defects, yet he ventures to believe that, to those who have studied the subject, there will be found, amid things useful, some points hitherto obscure possibly made clear.

MEASUREMENTS

OF

THE GREAT PYRAMID

RECORDED IN HISTORY.

As some persons of late, during these latter days of the Great Pyramid controversy, have attempted to show that the modern theory is in error because it accords not with the chief measures as given by successive ancient authors and alleged measurers, it has become requisite to consider whose measures are to be most relied on, because no true and permanent advance can ever be made until this point is conclusively set at rest. After that it is settled, we shall then perhaps be able to distinguish in our own minds which of the inferences drawn from the ancient alleged measures or the modern ascertained dimensions are most to be trusted.

In searching through the chronicles of the past for the earliest record pertaining to the knowledge of a metrological meaning being involved with the Great Pyramid, we find that more than two thousand years ago Herodotus wrote that he had been informed the Pyramid was so constructed that "the area of its slant side should be equal to the square of its height."

More especially within the last two centuries the belief that the Great Pyramid was originally intended as a gigantic monument of metrology has been gradually received in Europe, as well as in America, "not so much though as a place of frequent reference for those things, as for preserving safely, during some thousands of years and through all intervening revolution of nations, empires, and religious creeds, the grand standards of metrology, true to their original settlement in old primeval times, for they were considered then, as now, to form some of the most necessary material means of civilization; yea, even the very rules whereby all men's rights and properties are set forth, distinguished, and valued, the alteration whereof might bring much inconvenience without any prospect of advantage," as an anonymous author on the Great Pyramid wrote in the year 1706.*

In 1632 George Sandys gave to the world what information he had collected about the Pyramid during his travels in the East. As, however, his writings are of a nature that, in our opinion, tend but little to scientific accuracy, we pass them over, arriving at the year 1637, in which John Greaves, Savilian professor of astronomy in the University of Oxford, visited the Pyramids. He was indeed the earliest person who attempted to make an exact measure of the structure, and for the purpose of being as accurate in his determinations as possible, he had constructed a measuring radius ten feet long,

* "Life and Work at the Great Pyramid." Smyth. Vol. iii., p. 116.

which was carefully divided in ten thousand equal parts,* so that he could employ it for measuring up to the one-thousand part of a foot or the 83·3 part of an inch. It is worth our while to dwell here, and ascertain in the Oxonian professor's own words his description of the Great Pyramid, and his measurements of some of its parts. In the "Pyramidographia," published in 1647, are the following remarks :—

"The first and fairest of the three greater pyramids is situated on the top of a rocky hill in the sandy desert of Lybia, about a quarter of a mile distant to the west from the plains of Egypt, above which the rock riseth 100 feet or better, with a gentle rising ascent. Upon this advantageous rise, and upon this solid foundation, the Pyramid is erected, the height of the situation adding to the beauty of the work, and the solidity of the rock giving the superstructure a permanent and stable support. Each side of the Pyramid, computing it according to Herodotus, contains in length 800 Grecian feet, and in Diodorus Siculus' account, 700. Strabo reckons it less than a furlong, that is, less than 600 Grecian feet, or 625 Roman, and Pliny

* Truly this measuring radius of Professor Greaves must have been a remarkable piece of workmanship for the period in which he lived. I have felt disposed to doubt the accuracy of the record, given by Birch in his edition of Greaves' works; yet, on referring to it, the 10,000 parts are unmistakably stated. Such divisions could not be read off without a magnifier; yet there is no statement that Greaves used any such aid to help him in reading off of the measurements. The case in which this radius was carried is said to be still preserved in the apartments of the professor of natural philosophy at Oxford, but the radius itself has disappeared. I still strongly suspect an error of a cypher in Birch's rendering.—ST. J. V. D.

equals it to 883. That of Diodorus Siculus, in my judgment, comes nearest to the truth, and may serve in some kind to confirm those proportions which in another I have assigned to the Grecian measures. For measuring the north side of it near the basis by an exquisite radius of 10 feet in length, taking several stations, as mathematicians use to do when any obstacle hinders their approach, I found it to be 693 feet according to the English standard, which quantity is somewhat less than that of Diodorus Siculus. The rest of the sides were examined by a line, for want of an even level and a convenient distance to place my instruments, both which the area on the former side afforded."*

In 1647 De Monconys, in 1658 John Thévenot, a celebrated French traveller, and a few years later Melton, an English traveller, all state the length of the base of the Great Pyramid as being 682 feet (French), equal to 728 feet English. Between the years 1685 and 1702 John Matthew Chazelles visited the Pyramid, and he found that very remarkable and now valuable conclusion, that the structure was correctly oriented. Cassini, whom he assisted in drawing the meridian line, says, "Chazelles made an actual measurement of the base of the Great Pyramid with a line, and found it to be 690 French feet, but

* Notwithstanding possible errors of the variations in the length of unit by which these ancient measures were obtained, it is obvious that great faults crept into the measurements on account of the *apparent* length of base which the Pyramid would represent at the surface of the sand and rubbish accumulating about it as it grew older. We have no proof that any of the early measurers cleared away the sand and rubbish so as to ascertain the actual base at its veritable foundation on the rock.

as it stands *on an uneven plot of ground*, raised in the centre of the side of the structure, it will be necessary to subtract something from this length to arrive at the proper base."* Now, is it not surprising, nay, outrageous, to find two men like Cassini and Chazelles, the former a professor of hydrography at Marseilles, and the latter who undertook the journey to the Pyramids expressly to measure them, should arrive at no more correct result than the mere imagination that "something" must be subtracted from this 690 feet to give the true base line? Why was not the height of the uneven plot of ground above the corners, from which the line was stretched, also measured? It seems incredible for such men to have supposed that vast piece of masonry as merely resting on the "uneven plot of ground" that Cassini alluded to. Why did not Chazelles prove to himself, what he might so easily have done, that, at the corners even, sand and debris were heaped up around the pile, and that the true base, being thus hidden out of view, could not be measured? Yet, to show still further the mere guesswork manner in which these men drew their conclusions, Cassini "proposes to reduce the measure by 10 feet on that account, but we may, with as much reason, deduct 8 feet, and this will bring M. de Chazelles' measure in accordance with others which were made about the same time."†

In 1693, Fulgentius of Tours, a Capuchin friar,

* Ann. de l'Academie des Sciences, Paris, 1702.

† "The Great Pyramid, Why was it built?" Taylor. Edit. 1864, p. 9.

and, about the same time, De Nointel, the ambassador to the Sublime Porte, stated the base line to be 682 feet. Here, again, John Taylor's words are most expressive: "It is impossible to avoid suspecting that these several authorities for one and the same measure derived their information from one common source, and that the most they did was to see that it was verified by their own measurement."

From the date of the last of these so-called French measurements, the Pyramid appears to have been untouched by rod or chain until the year 1763, when Davison, the British consul at Algiers, found the base to be 746 English feet, at which time he also discovered that hollow over the principal apartment of the Pyramid with which his name has ever since been associated, "Davison's chamber," and which, together with the other four "chambers of construction," now constitute so important a feature in the modern metrological theory.

Not many years after Davison's measurements were published, the French began to attribute a metrological intent to the Pyramid. Accordingly, in 1780, we find Alexis Paucton, a distinguished French mathematician, who, amongst other works, wrote a remarkable quarto "Treatise on the Weights, Measures, and Moneys of all Countries, Ancient and Modern," as well as a "Dissertation on the Pyramids of Egypt," believed "that this prototype or natural standard was the measure of the earth, and that the Pyramids were built to record the dimensions of the earth, and also to furnish an imperish-

able standard of *linear* measure." (The italics are ours). Paucton's work, too, was dignified with the approval and privilege of the king. His title-page points strikingly to the direction or stand-point from which he viewed the Great Pyramid, and there can be little doubt, no matter how wide of the fact his views were, that the position he took has done much since to direct men's attention towards ascertaining, if not in large measure proving, either the pure or idolatrous intentions of the builders. We have referred to Paucton's title-page, wherein he states that "God had arranged everything in measure, weight, and number," words significant indeed, as touching the conclusions that have been deduced since his time. On the reverse of that page he adds six scriptural quotations, exhibiting at once the great charters to mankind from which we gather that all things should be justly weighed and measured. In some of the opening pages of his work, Paucton suggests certain theories by which he supposed the ancients might have preserved and have handed down to us their systems of weights and measures, following this by showing what he believed to be the method they had adopted to effect an object so sublimely excellent. Thus he has it—"In the first place, they have preserved their linear measure on a monument as durable as a monolithic rock; and, in the second place, upon a model or type taken from nature, as ingenious and exact as the pendulum itself, viz., a degree of the meridian." Paucton, in speaking of the "ingenious and exact" model, supposed

that the original base of the Pyramid was one five hundredth of a degree of latitude, or that the degree was equal to twenty thousand Nilometer cubits, or five hundred times a certain stade measured in Laodicea by Mr. Smith of London.

Now it is right for us here to inquire from what source did Paucton obtain his data for drawing these conclusions. We find, alas! from nothing higher than mere travellers' notes; these taken, too, without reference to the original existence of the casing-stone covering, leaving out of the question the since discovered corner sockets. We need not, then, add further proof to exhibit the unwarrantable reasons Paucton possessed for concluding as he did; besides, we do not at all know, neither could he more than conjecture, that the three hundred and sixtieth part of the circle was picked out from all other possible numbers and used as the unit of measurement for that figure in the early days of geometric knowledge, either in that land or anywhere else.

Not many years later another Frenchman propounded similar views, viz., M. Romé de L'Isle, in his "*Metrology, or Tables for understanding of Ancient Weights and Measures:*" and poor De L'Isle, writing in such terribly evil and tumultuous a period, what was his opinion of Paucton? Properly enough, he draws the conclusion that *time* should form an important element in any system of metrology. From what has since been ascertained we can but deplore his ready credence to, his showy praise of

Paucton's theory as to the "ingenious and exact" measure of the meridian degree, which he considers in its original conception (and here he would not have been far wrong had the theoretic conception been the ancient fact), "has a just title to rank as one of the chief works of the human mind." We thus discover that De L'Isle's views, interesting as they are in showing historically modern theories of the Great Pyramid, are positively useless, now that, under hitherto existing causes of error, certainly the closest approach possible to the true length of the original base, as well as of all the most important dimensions, has been made, short of clearing the old Pyramid's side of that vast heap of sand, casing-stone debris, limestone, and masonry fragments that through Time's long day has there-around accumulated.

At the end of the last century, when the French Institute of *savans* were sent out to Egypt with the young Bonaparte and his army, was the great modern initiative step taken in bringing about the shedding of some light over the opaquest mysteries of Egyptian Pyramids, particularly in reference to the three principal that are situated on the Jeezeh hill. The *savans** worked with unremitting zeal in their attempt to ascertain the positively true linear dimen-

* Excepting always one of them, who, impatient to get at the secrets of internal construction of one of the small Pyramids, attempted to batter it down with cannon. But then, he was a military man, and the military mind sometimes revels in very peculiar notions of men and things, even when holding for the time some staff employment in arms—scientific service. But of this we shall see some more examples before leaving the Pyramid.

sions of the structure, and we shall presently see with what success their laborious undertaking reached its climax. The height was measured on two modes, trigonometrically, as well as by ascertaining with a very accurate measuring staff the height of each successive step, and afterwards adding the whole together. The step-measurement height was performed by MM. Jomard and Cecille, in the first instance, before anything had been discovered concerning the existence of the corner sockets. These measures were afterwards repeated for verification by Le Père and Colonel Coutelle, after their invaluable bringing to light of two, out of the now ascertained existing four, corner sockets. Verily, that month of January, A.D. 1801, is a date ever to be remembered in connection with Great Pyramid investigations; for during its hours Le Père and Coutelle made their discovery which in modern times may be considered as the index pointing to the ascertainment of the true inclination of the Pyramid's side, and therefore the initial step in the recent more probable proposition of the original π proportion. The importance of this discovery appears so great in tending to the elucidation of the yet to be deduced whole chain of facts and symbol, that we include here a translation from the great French* work thus—"In the month Pluviose (that is, the fifth month of the French republican calendar), year IX. (January, 1801), MM. Le Pére and Coutelle, in excavating at the foot of the Pyramid, towards the two angles of the northern side, found an

* "Antiquites Memoires," vol. i.

esplanade, which is the ancient '*sol*' or ground plot of the monument, *i.e.*, of the pedestal '*socle*' on which it reposes. Upon this esplanade, and in front of the apparent extremities (of the building) they further discovered two sockets, '*encastrements*,' almost square, cut in the rock. They recognized that these sockets were well on a level, their angles sharp, completely distinct, and rectangular. The measurement was made from one angle to the other, and on the outside the measure of the base was taken, and on measuring the line between them its length came out 716 feet 6 inches French = 232·747 metres = 9163·45 British inches." Coutelle further describes the excavation at the north-east angle, and mentions the depth of the socket as being 207 millimetres, and occupying a space 3·9 by 3·4 metres.

Subsequent to the grand discoveries of the French *savans* we have to pass on and consider the work of that right noble-hearted investigator, Colonel Howard Vyse; and although we have elsewhere bestowed our tribute of regard to his memory, we cannot let this opportunity pass without again alluding to it: for never, as it appears to us, did any one in antiquarian research more profoundly and untiringly adhere to the object—and that grand, pure, and noble—on which his heart had been set than this colonel, pursuing onward and onward his tiresome labour until he had proved, as far as was then to him possible, the end and aim of the Pyramid builders.

Colonel Vyse evidently was not in the least

degree conscious of the importance which has since been found to be veiled in the proportions of the Great Pyramid. Little did he suppose how his store of facts would, thirty years after, be drawn upon, and contribute the groundwork upon which the metrical theory was to be built, and which urged Piazzi Smyth to undertake his recent expedition to the Pyramids, in order to verify the measures of the colonel or disprove them, and add to their number and appositeness for scientific purposes. This last expedition (but one, to which we have already felt bound to direct attention in terms anything but praiseworthy), we should add, undertaken by a man eminent in those particulars of exact measurement and inference, accustomed to the uses of the most accurate measuring instruments that are only to be found in astronomical observatories, and practised in the most approved methods of observation, not only confirmed the (comparatively to his own) rough dimensions of Howard Vyse, but performed such an extraordinary quantity of measurements of almost every *accessible* feature, and in such a variety of ways, as to reduce the residual errors of observation to the least possible degree ever yet attained in measuring any monument of the ancient world. Therefore let us say, in conclusion of this paper, that the theory first grounded on the measures of Howard Vyse, is not only verified by the more recent measures of the Scottish Astronomer-Royal, but shown to be more accurately founded, and abundantly testified to by several concurring series of

features, phenomena we might almost call them, than ever had, or could well have, been previously imagined.

We take it for granted that the facts about measurers and measures which have now been briefly put together, are sufficient to convince the most sceptical that no reliance is to be placed on any one of them previous to those made by the French, to which Vyse added much, and Piazzi Smyth even more, with completer detail, carried out with some of the most approved methods and appliances, employed with an astronomer's skill; therefore, we can trust in our investigations to his measurements, or rather his measurements combined with his own discussion, most full, fair, and discriminating, of the respective values of each of his predecessor's works, only; not, indeed, as giving perfect results, but as stating the limits within which the true quantity must be contained; these being arrived at, in his own case, by full statements of the circumstances of observation, and illustrated by measures repeated frequently three, four, or more times, on separate days and distinct occasions; and, let us add, that since these final measures and resultants of long discussions under known circumstances alone are to be trusted, the recent opposition which has been offered and based upon the discordance between them and ancient alleged and even egregiously absurd so-called measures, or even guesses at measures, is as baseless as it is puerile.* As well

* The opposition which has been offered, indeed, reminds us of parallel cases in the history of astronomy. Take, for instance, the Copernican

might men refuse to admit the Newtonian theory of gravitation, because it is very different from many previous attempts, and most sorry ones too, to explain the movements of sun, moon, and planets.

theory of the *real* motions of the heavenly bodies, which was despised and gained few disciples at first, because previous to its announcement, about A.D. 1500, astronomers had been trained in the erroneous Ptolemaic system, and the Almagest was the chief book of their doctrines—nay, for more than a century was it opposed.

What, too, may not be said of the sublime Kepler, who was so scoffed at for announcing to the world those three great laws which constitute the finishing off to perfection of the Copernican system, and who, in answer to certain calumniators, uttered those memorable words, which can never be recalled more fittingly than with reference to the subject which now engages our attention: "The day will soon break, when pious simplicity will be ashamed of its blind superstition; when men will recognize truth in the book of nature, as well as in the Holy Scriptures, and rejoice in the two revelations."

AN EXAMINATION

INTO THE

CONDITION AND WORKS OF MANKIND

FROM THE CREATION TO

THE BUILDING OF THE GREAT PYRAMID.

To render our investigation of the questions involved under the title of this paper as clear as possible, it will assist much that we now ascertain all that we can of the condition of man and the state of his religion and civilization at and immediately preceding the period during which this "marvel of ages" was erected, and, as directly connected therewith, the first and obviously most important and leading fact to be settled, is the Pyramid's *date of erection.* As what we state in the present paper are necessarily in chief part now only assertions—the proofs of which are elsewhere developed—we desire our readers to remember that, on astronomical grounds, that date was formerly shown by Sir John Herschel, and is now confirmed by the Scottish Astronomer-Royal, as one of the results of his personal examination of the angular position of the entrance passage, relatively with the star α Draconis, to be 2170 B.C.;* whilst hieroglyphically, and quite independently, William Osburn† has shown that the year 2170 B.C. falls into

* "Life and Work at the Great Pyramid," vol. iii., p. 283.

† "Monumental History of Egypt."

the very middle of the time of the fourth dynasty, which accords, too, with the account the priests told to Herodotus when he visited the Pyramids, viz., that it was built during the reign of Shufu, or Cheops, as he is variously called, one of the best known kings of the said "fourth dynasty" of Egyptian monarchs:
(3) and in which one case the priests have since been proved to have told the truth, through the discovery by Howard Vyse of the painted cartouches of Shufu in the "chambers of construction;" so that on this question of date, established by three independent methods, there can be no doubt that the year 2170 B.C. is remarkably close to it, if not exactly the point in time from which we may count that structure's existence. Having thus fixed the first point in our inquiry, we may on secure ground proceed to examine, if any, what were the great events known to have happened on, and therefore influencing the earth in those days, as well as the effects these had on the men then living; also, what were the conditions under which the human family were at that time placed in the countries constituting their Eastern cradle-land.

The precise date of the Noachian Deluge is not known, as the three different versions of the Scriptures, viz., the Hebrew, the Septuagint, and the Samaritan, differ from each other by some centuries; and on all sides wherever we direct our inquiry, so vast disputes as to the most trustworthy of the three only accredited versions appear, that even our most widely-spread form of the Christian Church, the

Church of England, hesitates, and has not attempted to fix any date for it, the authorities varying from 2327 B.C. to 3246 B.C. In the present case it is less necessary to fix or approximate to an absolute date, as the limits between which it must lie have been given; and as we are equally informed in the text of every version that the dread incident reduced the living number of mankind to eight only, it is perfectly clear that at least some considerable stretch of years must have intervened between its date and the building of the Great Pyramid,—not on "gradual development" grounds, as Dr. Hooker, the president of the British Association Meeting at Norwich, would desire us to utter as our creed,—but on high and sublimely ordained ground, which permits, not on humanly devised foundations, but on divinely ordained principles, the growing up to maturity of succeeding generations of mankind, so numerous a horde of whom were necessary to the completion of such a work.*

We gather from the account of the generations given in Genesis x. that several of them grew up in succession and dwelt in the Mesopotamian plain; and from the first verse of chapter xi. we further learn, "the whole earth was of one language, and of one speech;" and in the following verses, "It came to pass, as they journeyed from the east, that they found a plain in the land of Shinar; and they

* We have given the last few sentences mainly to answer some recent inquirers, who, having studied the writings of the early Arab authors—each of whom gives a more discordant and imaginary account than his predecessor—are left in doubt whether the Pyramid preceded or succeeded the Flood.

dwelt there. And they said one to another, Go to, *let us make brick, and burn them* throughly. And they had *brick* for stone, and slime had they for mortar. And they said, Go to, let us build us a city and a tower, whose top may reach unto heaven." In the foregoing words is contained the only safe and inspired information we possess of the earliest of man's structural operations on the face of the earth subsequent to the Deluge. That there was a city builded previous to the Flood by Enoch, the Cainite, we believe from Genesis iv. 17, but as to any other structural work in masonry or brick previous to Babel, after the Deluge, the Scriptures are entirely silent.

To enable us to judge how much men had been advanced, up to the time we are considering, as experienced artificers, and how much knowledge they must at one period have in some other way acquired, to suffice them to execute the unparalleled masonry structure concerning which we write, it is proper at this point to further inquire what practical development of the mechanic arts was known in the prediluvian ages. We say "prediluvian;" for it amounts to certainty that Noah and his family must have been aware of all that was known or practised on the earth previous to the Deluge, as distinct and separate from what we read was communicated to him as the specification for the Ark, and which knowledge was doubtless handed over to his descendants.

The immediate descendants of Adam and Eve,

viz., Cain and Abel, were the heads of the two sections—husbandmen and shepherds—into which the human family was in prediluvian times divided; and when, after the death of Abel, Cain fled eastward, as a murderer, into the rugged and mountainous district afterwards called the land of Nod, he and his clan were *instructed* in the arts necessary for their new field of labour. It is clear, from Genesis iv. 20, that they had been taught to tame and domesticate cattle; from verse 22, that they knew how to work the metals; hence we may fairly and with certainty assume that these progenitors knew how to manufacture and use *metallic* tools, and really were not of that rude and uncivilized order of mortals who, left for long ages to plod on untaught, had no ideas of anything more elevated than lumps and implements of flint and wood; until by the invasion or peaceful immigration, or both combined, of the nations further civilized than they, the use and manufacture of the metals was brought home to their senses. That these Cainites, too, were highly civilized we learn also from verse 21, wherein the very chief of musical instruments is shown to have been a possession during their bitter exile. Nevertheless, they were an irreligious race—had, at least, ceased to acknowledge the true God; and as separated from Him, they bore the degrading title of "the sons of men," whilst the Sethites,*

* *Sethites.* After the death of Abel the right of primogeniture was transferred to Seth, the third son of Adam. He thus became the chief of the shepherd section.—See Osburn's "Religions of the World."

or shepherd section, were known as "the sons of God" (Gen. vi. 2). For long ages the two sections had kept distinct, but at last (Gen. vi. 2) the Sethite men intermarried with the Cainite women, the consequence of which was the practise of all the vilest sins and abominations, and, save in one single family where the knowledge of the true God was maintained, both He and His commands were forgotten; and, as we have before remarked, all the available constructive knowledge of the race, together with what addition may have been necessary, was centred in Noah, as he was singled out by the Divine hand and directly *inspired* as to the material, form, and dimensions of the Ark (verse 14, *et seq.*).

Now it is well to particularly note at this place, although we shall have occasion to employ the fact subsequently, that to every one (except that unfortunate part of the community who deny the truth of the Pentateuch) it is most palpably true that the mind of man was *divinely inspired* as to his operations in building the Ark; that in no way did it constitute any *human* conception; that left to himself man had not then—particularly as a shepherd—either the experience in the structural arts, or skill to design and carry out such a work as it was.* Having thus traced down to the time immediately preceding the Deluge the condition of mankind as tool users and constructors, we are in a position to

* That is, to plan and build a vessel of larger cubical capacity than the "Great Eastern" of modern times; whose misfortunes have been more than her triumphs, and not all the wealth, the science, the practical engineering of the present, have been able to render her a successful speculation.

infer, approximately, the amount of such merely human knowledge that was carried forward by the eight chosen persons to the commencement of the postdiluvian epoch.

Already we have drawn attention to the first work chronicled as having been undertaken by the Interamnian people. The terrors of the Deluge were still vivid in their recollection; but the fear and acknowledgment of its Author had departed from them. Thoroughly vile had they become: full of vain glory, said they one to the other, "Let us make us a name!"

The sacred record contains no allusion to any postdiluvian work of earlier date than the city and tower of Babel; and in all the excavations that have been made by Layard, Taylor, Loftus, or Rawlinson, no remains have been discovered that can be attributed to even so early a date—nothing, in fact, previous to the foundations of certain rude and earthy proto-Chaldean temples of certainly not remoter date than 2000 B.C. Of mere sun-dried brick and mud (slime) are we told that this apparently earliest postdiluvian building was composed; and now we *know*, *i.e.*, by modern discovery, investigation and proof, that it could in that vast Mesopotamian plain have been of no other material: for then, as now, was the region constituted of a widespread alluvium of clay and mud, which the Euphrates had deposited through time, and to this day does so deposit. No solid building material was there in the shape of stone to be quarried. Standing only on a naturally sinking

foundation was this Babel, which brought about the dispersion of our family; and as perishable as its builders, both they and it have vanished, and their place is nowhere to be found.

With such materials, requiring little or no skill in handling, we may feel pretty sure that at this period the mechanic arts, to these early men, who had by this time receded from all that was exalted and true, into the black depths of idolatry, sin, and grovelling degradation, must have existed in the lowest degree; indeed it would appear that the plain was chiefly desert, or grain-producing, and serving for pasturage; timber being scarce there then, as at this day.

And while in this state they commenced to build their city and tower in mud and clay, the mighty crash came. A still mightier was enraged at their iniquity; the door of heaven thrown open, and the proclaiming voice re-echoed, "Let us go down, and there confound their language that they may not understand one another's speech." The scattering of the human race followed; and one of the sons of Ham, fleeing before an irresistible impulse from the East, came to settle in the land of Egypt.

We thus see, that up to the day of the scattering, the postdiluvians had receded from a state of practical skill which they possessed at the building of the Ark, down to nothing better than the erection of heaps composed of the soft materials so liberally supplied them by nature, and that, too, in a state requiring the least skill conceivable in forming their buildings out of it; so that it appears most reason-

able to conclude that the cutting and hewing of stone, still less the employment of it in buildings, was unknown to so degraded a race as the descendants of Noah had then become.

What, however, do we find the horde headed by Mizraim doing, immediately on their arrival across the Isthmus of Suez? So soon as a suitable place for a settlement was met with, a city was built by them on the eastern bank of the Nile, and just at the point where the river begins to branch off into mouths.

In his "Religions of the World," William Osburn, than whom it is impossible to cite a more experienced and truthful inquirer into all questions having reference to ancient Egypt, says this city "was afterwards called by the Greeks Heliopolis, that is, 'the city of the sun.' It was one of the three capitals of Egypt, and, according to all known authorities, the oldest of the three. As the city of Heliopolis would likewise be the first spot in which immigrants across the Isthmus of Suez would find land solid and fertile enough for a permanent settlement, there is every probability that Heliopolis was the first city founded by the new settlers."

Afterwards, tradition says, other cities were built by them, city building being begun and continued as a religious practice. The cities contained the temple of the god in whom they so completely confided, each having also its own special god, whose function was tutelary, thus forming the origin of the horrid Pantheon of ancient Egypt, arising from the

apprehension that no one being was equal to the task of presiding over and managing the various settlements of mankind. "Out of this same mistrust," writes Osburn, "arose likewise the idea of assigning to certain of the new gods the direction and control of the heavenly bodies. One divinity presided over each of them, and by him its motions in the heavens, and its influences upon the earth, were entirely regulated."

"Adam (*Athom*), the father of mankind, was upon this principle associated with the sun, the author of all fertility upon the earth, in the idolatry of Egypt; . . . . the circumstances that the patriarch-worship is one of the common elements of all idolatries, and that Adam at Heliopolis was associated with the *setting* sun, render it probable that these corruptions had taken place before the dispersion from Babel, and that the Mizraites, emigrating thence westwards, took along with them the worship of the sun in that quarter of the heavens towards which their steps were directed."

Of what materials these alleged Mizraite buildings were composed we know nothing—for, one and all, they have passed away; but seeing that sun-baked bricks of alluvial mud were familiar to these early men in Shinar, and seeing, also, that the Delta in which their first cities stood supplied an abundance of similar material, and out of which we have it recorded (Exodus i. 14) that the cruelly-tasked Israelites, under the dominion of a Pharaoh (Sethos II.) afterwards made brick; whilst, too, no good

building stone was near at hand, and even though there had been a sufficient supply of stone close to their first building sites—it is indeed difficult to suppose, nay, it is contrary to all experience of the progress of the human race when left to themselves, to infer, that they should of their own accord so rapidly rise as constructors as to proceed with *stone* buildings on their immediate arrival in Egypt. We must in support of our view further bear in mind, that during this the *very early career* of Mizraim in Egypt, there is nothing extant of special divine interference on the part of any works they constructed; to a religion of utter idolatry had they yielded, yet acknowledging, with an unparalleled awe and fervour, a Great Unseen, in the grasp of whose mighty hand they had trembled at Babel, through their unbelief in the promise that there should not be a second Deluge. But of these alleged, and to a certain extent necessary, proto-Egyptian buildings we have no remains, nor is it reasonable for us to expect that anything important of their structural works should have come down to us; for the similar substanced Babel, in spite of its enormous size and not very much older date, has nowhere been found, although Babylon be its reputed site. Founded in alluvium, and composed of unburnt alluvial mud, together with the same order of works which succeeded it, it as well as they have either in part or altogether to alluvium returned, or have sunk deep down out of recognition into the vast abyss of such unstable foundations.

To have built cities of *stone*, men must have possessed a considerable practical acquaintance with the use of metallic tools, by which alone such could be cut and dressed in large quantity preparatory to fitting into any building. Besides, stone is a material which cannot be builded or cemented together with mere slime or mud; a properly compounded mortar for such style of structural work is imperative. Wherefore, the inevitable conclusion upon the foregoing investigation is, and only can be, that whatever may have been the point to which, as artificers and constructors, these early Mizraite settlers had reached, we have now no opportunity of ascertaining it from any monumental remains; whilst, from certain reasons of climate and otherwise, if any really good building on stable foundations had been erected by them, there is every reason to believe that important relics pertaining to it would have been even now in existence, just as there are, in abundance, of a shortly succeeding period, and from them without interruption down to the present day.

How long those proto-Mizraites dwelt in the Eastern part of the Delta we are equally ignorant of, for positive Egyptian history does not begin until the time when Menes crossed over to the western bank of the Nile, and founded the famous city Memphis. This Menes, it is agreed by all authorites, was the direct descendant of Mizraim, and, as his name signifies, a "hurdle-maker;" but what he built of Memphis, and how, we have no remains to guide us; indeed, he is only known to us at all

through the extremely doubtful list of the dynasties which have come down to our days from Manetho. Of his immediate successors, too, we know no more throughout the first three dynasties; but arriving at the second king of the fourth dynasty, we find *his* existence most amply testified to by the tombs and pyramids at Memphis. Wherefore, thus has Mr. Fergusson truly put it, "Stretch the history of architecture as we will, we cannot get beyond the epoch of the pyramid builders."* That epoch we have before stated (p. 75) to be astronomically, historically, and hieroglyphically fixed with the building of the Great Pyramid in the year 2170 B.C.

With what we have up to this point written, few, if any, will be found to materially differ upon. But at this particular point the objectors close in upon us, and we are met by the same excellent author, Mr. Fergusson, thus—"It seems impossible to find room for the *now ascertained facts* of Egyptian chronology, unless we place their erection (the Pyramids') at least three thousand years before the Christian era;"† and further, "One of their great aims was to preserve the body intact for three thousand years, in order that the soul might again be united with it when the day of judgment arrived."‡

A man of no mean authority is this Mr. Fegusson;

* History of Architecture, chapter "On Ethnography as applied to Architectural Art," vol. i., p. 44.

† History of Architecture, book i., chapter i. on "Egyptian Architecture," page 81, vol. i.

‡ History of Architecture, book i., chapter i. on "Egyptian Architecture," page 83, vol. i.

but it may be asked of him what are his *now ascertained* facts which *we* have italicized in the first of the two last quotations? To our question we find no answer in his most erudite work now before us; hence we conclude, as alone we can when he has left us in such an irreconcilable state of uncertainty, that he bases his testimony upon other assigners of dates, and yet he is different from all of them, being nearer to Lepsius than any of the others. It is noteworthy here, by way of parenthesis, that Rawlinson and Sir Gardner Wilkinson assign a date not far removed from that given astronomically by Sir John Herschel and Professor Smyth, and hieroglyphically by Osburn—whilst Renan, Lesueur, Bunsen, and others, stretch it upwards to between 4000 B.C. and 5400 B.C.; but "Zadkiel"* transcends

* We must remember that Mr. "Zadkiel," of the notorious Zadkiel's prophetic almanac, is one of those few who still profess in *astrology*, as distinguished from *astronomy*; who utter as their creed that men and mundane events are subject to, and controlled by, the auspicious or inauspicious influences of the stars; who believe the earth to be the centre of the universe, and not more than 376,965 miles distant from the sun; who declare the unerring laws of Copernicus, Kepler, and our own Newton to be fallacies, even at this time when the most transcending discoveries in astronomy have been based on these laws alone. How marked a contrast then do astronomy and astrology exhibit in the present Egyptological or Pyramid age and date case; when with the former, the deduction of data rests on the strictest methods of modern science, confirmed too by the testimony of the hieroglyphs, and quite within the best ascertained data of scriptural dates; whilst in the latter case, the deduction from blind astrology places the date of the Pyramid building far beyond any datum which can be accepted as evidence, prior even to the deluge, yea, even earlier than the remotest ascertained date of the existence of intellectual man on our earth. Most noteworthy is it that out of all the authors, the least reliable or most atheistic, such as Lesueur, Renan, and Bunsen, approach the date given by the astrologer!! whilst the most reliable and least atheistic, basing their calculations on the unerring hieroglyphic record, gradually approach nearer to the date given by the astronomers Sir John Herschel and Piazzi

all in vouching as true that this date cannot be less than 7100 years B.C. Mr. Fergusson may also have founded much of his adopted chronology on Bunsen, who says—and the world has hitherto been accustomed to be so implicitly led by him—"there exist Egyptian monuments, the date of which can be accurately fixed, of a higher antiquity than those of any other nation known in history, viz., above five thousand years."* We hope on some future occasion to inquire into the testimony upon which Bunsen's assertion is made; but now, to proceed with the more direct purpose of this paper, let us again direct attention to the fact that the *relatively* earliest architectural work of man actually found anwhere in the world exists in the rock-cut tombs and pyramids at Jeezeh, hewn out of the solid rock, and piled together symmetrically and mechanically, of well cut stone in the days of the fourth dynasty of Manetho, as told by the priests to Herodotus, and amply testified to by the painted cartouches of Suphis in both, as well as by the pictures on the tomb walls.

In the fourth dynasty, then, the Mizraites had attained, as elsewhere shown in the realization of

Smyth; yea, the best of them, Osburn, positively coincides with the most accurate astronomical inference. This circumstance must beyond doubt have its due importance recognized in weighing evidence as to what propositions relating to the Pyramid are to be relied upon; for nothing in modern astronomy is capable of being twisted to any pre-conceived notions, and its record, absolutely independent of anything *written* in the sacred Scriptures, becomes, when able to touch on any of the same subjects, an inestimable witness.

* "Egypt's Place in Universal History," vol. i.

such a building as the Great Pyramid, the very highest pitch of perfection to which the masons and stone-cutters' arts have ever reached in the history of the world; and, whilst having explained this astounding fact, let us pause a moment for the purpose of noting, as of most emphatic moment not only to the purposes of this paper, but more especially to the monumentally-written history of the human race, the discovery, that most suddenly, as constructors of buildings and artificers, these Mizraite men emerged either from a people of no buildings* whatever, or from the lowest state of existence as builders, up to the production of the most exalted, accurate, hugest, most massive, and altogether most remarkable building ever conceived. And what a state of knowledge does the erection of such a structure imply! The most accurately oriented building ever known up to the present day; so that this, the very oldest of all the old structures on the face of the earth, is under 5 minutes of angle in error. Here we see it most unmistakably written, in the first cut stones of the ancient Lybian desert, how highly the practical use of geometric, combined with astronomical science must have been known to the designer of such a work; but not only so, for it is most difficult to see how, nay, as the positivists reason, it is impossible to them to see how,

* It is not at all improbable that cities or buildings may have positively not been in existence previous to the Pyramid, especially when we consider that the climate of Egypt is of that nature that human beings can, and do, dwell out of doors, and it is known not to have altered since the building of the Pyramid.

unless we grant them time by innumerable thousand of years, or perhaps tens of thousands—and which we certainly do not, for the facts are all against them —it is most difficult with even our modern ideas of engineering to conceive how the stones of such a structure could have been cut at such an epoch, and that so accurately; yea, finished with more precision than even the best planing machines at present produced for surfacing stones are capable of. This, however, is not all, for the same primeval designer's knowledge of the chemistry of cements and mortar has probably never been surpassed, and we have no evidence that so much knowledge of that subject is even now possessed as the structure of the Pyramid exhibits in fact; at least, the exceeding number of theories and variety of opinion on the whole question of cements, propounded and adhered to by the members of our profession, seems pretty clear proof to the contrary.

As aforesaid, in reference to the skill of the Pyramid builder in the application of geometry and mathematics, the "development" band of Darwins, Crawfurds, Lubbocks, *et hoc genus omne*, who believe that they themselves are the direct descendants of a distinct line of beings, who set about the most laudable task of the "advancement of their species," until they have reached their present most exalted and self constituted pinnacle, the same impossibility meets them in reference to the chemical as well as all other questions that grow up in our investigations. For, say they, "such a rise in the

application of the arts and sciences could not have taken place suddenly; it must have been an affair (no matter what the Scriptures, dates, or any other evidence say) of nothing short of "gradual, and self development through enormous periods of time." All this clique positively stare you down with the assertion that if you give them paper and time enough to solve this problem, they can do it. Both paper enough and time enough they now have surely had, and still their proof has not come, at least if we rely, as we most surely may, upon the latest affirmation of Dr. Hooker, the president-elect (as we write) of the British Association at Norwich. And most solemnly we call them to mark ere it be too late, that prove such dogmata they never can, as long as truthful minds are allowed to read their Bible, and do not forget, which they are not likely to do, that "God made man in his own image." Most solemnly, then, is it demanded of this band of mortals, to pause ere they dare to pronounce their opinion as to God himself—or whether they think there be any God at all; for what is the inevitable conclusion to their now most profane premiss? We shudder at the thought of it; but it is our duty not to pass over such impious interference which at this stage of our inquiry has crossed our path. Nothing short of this "self-development," in very truth it and no other, must have preceded for time inconceivable yonder Pyramid, say they! Yea, tell us also—tell ye to the blind, what ye yourselves are now doing in "self-advancement;" from facts

outside holy writ we will declare to you your gradual retrogression.

Having thus brought into searching light one of the most popular of the modern profanities, we may next, for its benefit, briefly consider whether, in or about the actual Pyramid neighbourhood, there are any relics or evidence showing that there had been any moderate *rock cutting* or beginning of *working* in *stone* anterior to the date of the Great Pyramid, whilst we must be careful not to mix this point with that *building* itself, which we have before shown to be absolutely the oldest finished fabric.

The point before us is soon settled. And here we again have recourse to that excellent author, Mr. Fergusson; for although we have been compelled to differ with him on a question of absolute date, still the case is quite otherwise when dealing with positive, tangible existences. Mr. Fergusson, then, borrowing his facts mostly from that most trustworthy of Egyptian explorers, Howard Vyse, says, "Around the base of the Pyramid are found numerous structural tombs, whose walls bear the cartouche of the same king, Suphis, whose name was found by Colonel Howard Vyse in one of the previously unopened chambers of the Great Pyramid."*

In these rock-cut tombs, then, we get down to the fourth dynasty, but no further; and nowhere in the world can we penetrate deeper into the long vista of time situate between us and early man, as

* "History of Architecture," vol. i., p. 82; also Vyse's "Pyramids of Gizeh," vol. i., pp. 279, *et seq.*

testified to by the remaining works, excepting, of course, the Wadee Meghara tablets in the Sinaitic peninsula, for although superiority of age has long been attributed to certain Pyramids at Sakkarah, still Dr. Lepsius has now shown the Great Pyramid to be positively the oldest.

It is possible that these Mizraite men were *first* taught to work in stone in the cutting or hewing out of tombs in the living rock of the vast Memphis cemetery. This, however, is merely a conjecture; and we have still to repeat that the only fact brought to light by our investigation thus far is, that the Great Pyramid appears suddenly on the scene as the earliest perfect building, and remains the most perfect and exact on the face of the earth to this day. Besides the tombs, there were two other works, of most important nature apparently, carried out in the same mummulite limestone on which the Pyramid stands, but prior to the date of commencing the Pyramid itself; namely, first, the set of inclined excavated passages some distance to the north-east of the Pyramid itself, which seem to have been excavated as the model, or that particular work performed beforehand, wherein the stone hewers were taught to some extent the nature of the work they had to perform on the immensely extended scale at the very brink of the Pyramid hill; secondly, the peculiarly posited set of trenches on the east side of the Pyramid, which are now discovered to indicate, or rather coincide with, the angular proportions of the Pyramid itself, and in so far not alone constituting the

drawing or geometrical plan of the Pyramid angles themselves, but also affording additional opportunity for the practical tuition of workmen in the operation of cutting and excavating stone, not merely in the comparatively rough and ready way that stone cutters work nowadays, but as teaching them to carry out their operations as they were about being required to do in the Pyramid itself, with the keenest attention to dimension and angle, that is to say, teaching these artificers to work with precision.

Here, then, a certain band of the modern sects of rationalism close in upon us, bearing upon us (so think they) dangers dark, deep, carrying us right down into the very abyss of chaos itself, and they exclaim—"Tell us by what tools the wondrous stone cutting was done; for we agree with you that this thing 'Pyramid' is the very oldest in point of time that we can lay hands upon, built, on the authority of our Bunsen, Birch, and others, thousands upon thousands of years earlier than you believe*—so old, indeed, that it clashes with our oldest dreams, which, in fact, confound you, namely, that man was first a bone and stone tool using animal—after that he took to using metals; so that, according to our creed, this Pyramid was built in the bone or stone age of the world, only we require ten thousand

* The reader should bear in mind what we have before shown at page 75, how the dates given by Herodotus, hieroglyphically by Osburn, and astronomically by Sir John Herschel and Piazzi Smyth, all agree—whereas there is not the slightest warrant for assuming an earlier date than 2170 B.C.

years at least from you to explain it on the veritable principles of 'development,' which we swear are all true, to get from thence to our present advanced state."

We reply then to this latter-day creed thus—1st, That there are numerous indications in and around the Pyramid that the work of stone cutting there carried out was effected by the use of *metallic* tools. In the lower part of the entrance passage, namely, in the portion excavated in the living rock, the very indentations made by the workmen in using a metallic pick, or some such tool, indicate clearly how that passage was cut; whilst in the better preserved sockets at the four corners of the structure, the tool marks are still more visible, as testified to by Piazzi Smyth, and the engineer, Mr. Inglis, who assisted him at their uncovering; and, as further proof that the metals were used by the builders, we have only to mention the piece of iron found in the Pyramid by Howard Vyse. Regarding this piece of iron found in the Pyramid, the circumstances of its position are most convincing, and testify abundantly to its having been coeval with the building of the Pyramid itself; the following extract from Vyse's "Pyramids of Gizeh," vol. i., pp. 275-6, we should hope will satisfy the most sceptical:—"Mr. Hill discovered a piece of iron in an inner joint, near the mouth of the southern air channel, which is probably the oldest piece of wrought iron known.* It has

* "Lord Prudhoe is said to have brought from Egypt an antient iron instrument; and I thought that I had perceived the remains of an iron

been sent to the British Museum, with the following certificates :—

'This is to certify that the piece of iron found by me near the mouth of the air passage in the southern side of the Great Pyramid at Gizeh, on Friday, May 20, was taken out by me from an *inner* joint, after having removed by blasting the two outer tiers of the stones of the present surface of the Pyramid; and that no joint or opening of any sort was connected with the above-mentioned joint by which the iron could have been placed in it after the original building of the Pyramid. I also showed the exact spot to Mr. Perring on Saturday, June 24th.

'J. R. HILL.

'CAIRO, *June* 25, 1837.'

'To the above certificate of Mr. Hill I can add, that since I saw the spot, at the commencement of the blasting, there had been two tiers of stone removed, and that if the piece of iron was found in the joint pointed out to me by Mr. Hill, and which was covered by a larger stone partly remaining, it is impossible it could have been placed there since the building of the Pyramid.

'J. S. PERRING, C.E.

'CAIRO, *June* 27, 1837.

'We hereby certify that we examined the place whence the iron in question was taken by Mr. Hill, and we are of opinion that the iron must have been left in the joint during the building of the Pyramid, and that it could not have been inserted afterwards.

'ED. S. ANDREWS.
'JAMES MASH, C.E.'"

To these certificates Howard Vyse adds, "the mouth of the air channel had not been forced; it

fastening in the chamber containing the sideboard or shelf in the great temple at Abou Simbal. In fact, stone could not have been quarried without metal, which must therefore have been in use in the earliest times. The smelting of metals appears to have been an antediluvian art, and artificers in iron are mentioned in the Bible; but it is impossible to say in what state metals then were. In M. Rosselini's work people are represented cutting granite with a yellow instrument."

measured $8\frac{7}{8}$ inches wide, by $9\frac{1}{2}$ inches high." Besides, can any man in his heaven-born senses, and who is acquainted with the nature of stone-cutting and the resistance that stone offers to cutting tools of all kinds, allow himself to believe for one moment in the production of such unsurpassed workmanship, and on so enormous a scale, as this Pyramid is, by bone or even stone tools? The joints and surfaces of the granite blocks constituting the floor of the king's chamber are so true and perfect that Mr. Perring, who was Howard Vyse's engineer, believed them to have been produced by scraping and surfacing, in a way now practised by engineers in all cases where true surfaces or planes are required. Granite, we know, cannot be acted upon by manually operated tools of any material but metal. Indeed with the best steel we possess it is most difficult to deal with; whilst the cutting of it into large cubical blocks and parallelopipedons, with most smooth and even surfaces, could never have been effected by any other means. We need say nothing as to how the softer material of the casing stones was treated.

"But how can you substantiate this theory," is the retort thrown upon us, "when at the time this Pyramid was built we, on development grounds, are certain that the practical arts were not so far advanced that man could know the metals and their uses?" Again we reply—All the facts show that in this early period of the world man was *intellectual*, and *not degraded;* even as we read in infallible

testimony that he was frequently addressed by God the Creator Himself; directly inspired by Him as to His chief works—for instance, regarding the ark of Noah, the Mosaic tabernacle and ark, the temple of Solomon, and so on; and we read also in the book of Genesis that he was acquainted with iron and its uses.

There is positively no warrant whatever to believe that man has risen from a mentally and structurally degraded state; on the contrary, in the case of Egypt, it is abundantly clear that he has fallen in successive stages from the intellectual condition possessed at the building of the Pyramid down to being at the present time the very scum of ignorance and indolence, accompanied by immorality, degradation, and misery. Nor is Egypt in this respect solitary; for what may be said of Assyria, India, Persia, Greece, and other countries? What were they once? What are they now?

One of the concluding points which we have to notice in this paper, are the social conditions of the people at the Great Pyramid building epoch. As regards, then, the conditions of Memphite society at this particular period, we are fully informed from the tomb paintings: and they tell us of the wealth and home comfort of the period. We may well quote here from our oft-tried author, Mr. Fergusson, who says—"On their walls" (meaning the walls of the tombs) "the owner of the tomb is usually represented seated, offering first-fruits on a simple table altar

to an *unseen* god. He is generally accompanied by his wife, and surrounded by his stewards and servants, who enumerate his wealth in horned cattle, in asses, in sheep and goats, in geese and ducks. In other pictures, some are ploughing and sowing, some reaping or thrashing out the corn, while others are tending his tame monkeys or cranes, and other domesticated pets. Music and dancing add to the circle of domestic enjoyments, and fowling and fishing occupy his days of leisure. No signs of soldiers or of warlike strife appear in any of these pictures; no arms, no chariots or horses. No camels suggest foreign travel. Everything there presented speaks peace at home and abroad;* of agricultural wealth, and consequent content. In all these pictures the men are represented with an ethnic and artistic truth, that enables us easily to recognize their race and station. The animals are not only easily distinguishable, but the characteristic peculiarities of each species is seized with a power of generalization seldom, if ever, surpassed; and the hieroglyphic system, which forms the legend and explains the whole, was as complete and perfect then as at any future period. . . . . Nor is our wonder less when we ask how it happened that such a people became so thoroughly organized at that early age as to be willing to undertake the greatest architectural work the world

* At Wady Meghara, in the Sinaitic peninsula, a king of the fourth dynasty is represented as slaying an Asiatic enemy. It is the only sign of strife which has yet been discovered belonging to this ancient kingdom. Lepsius, Abl. II. pl. 39.

has since seen. . . . It is possible there may have been nations as old and as early civilized as the Egyptians, but they were not builders, and their memory is lost."

It has been suggested as a cause for the non-existence of remains of earlier stone buildings than the Great Pyramid, that wooden architecture was in vogue previously; and as proof of this the forms of many of the Egyptian temples, with their straight limbed and gaunt pylons, columns, and walls, coupled together at the top by equally straight beams of stone, sometimes carved into imitations of palm-tree trunks, are cited. Yet how can such be held as proof, when every one of them are many centuries later than the Pyramids? and we presume that no one would attempt to indicate that *their* forms (viz., the Pyramids) indicate a derivation from wooden architecture. It is, indeed, very reasonable to suppose that a wooden architecture—long before the day of the Great Pyramid, and in other lands—succeeded the Ark, as the grand and world-compelling example from which building in wood (the simplest of all materials to build with, but the least enduring) may have been followed out. Nay, it is quite admissible that if any buildings of any kind, other than and besides the mud-slimy Babel, did precede the Great Pyramid, that they were of timber in countries where that material abounded. But in Egypt there was never much wood, and though we gather from Herodotus that timber was used in the Pyramid building day for the great stages, frames, and

inclined planes by which the huge stones were raised up to the Pyramid's side as the building was going on, yet it seems to have been a rarity, in small pieces, and such as from their shape and quality would neither be used in building by themselves, nor lead to a method of working akin to that of the mason. Hence the argument supposed to be supported by the rotting away of a world of once existing wooden buildings in Egypt, does not lend any aid to the solution of the questions—"How it happened that the first stone building erected should have been carried out with such an extraordinary perfection of workmanship, and on so vast a scale?" or, "Why the Pyramid form should be the very first chosen for a stone building?" or, "Why in that peculiar solid form, certain of the best known mathematical ratios, which belong in ordinary geometry to linear forms, should have been so enduringly embodied?"

The Pyramid shape, indeed, stands out distinct from every other style of building ever known; and yet, whilst it must be conceded that the forms of the later Egyptian architecture, temples, and obelisks, and even some contemporary tombs, do decidedly indicate their derivation—on account of the very tying together and arrangement of their parts from previous wooden erections—yet why should such half and half things not rather *immediately* have preceded on natural grounds the purely stone buildings, than on the same grounds give place, after the wood, to the *intermediate* rising

up of a totally different and much more enduring order of stone architecture, and *then* make their appearance? The conclusion here, on the grounds of pure reason and human science, is, that in no way can the sudden appearance of the Great Pyramid at its remote age be satisfactorily accounted for: and this brings us to the final question, When, where, and on what other ground are we to seek its origin? One other ground only is there, and that to those who have searched for it unmistakeably plain.

APPENDIX.

Appendix A.*

The Great Pyramid of Egypt.

Ordnance Survey Office,
Southampton, *November* 9, 1867.

The publication of the elaborate work on the Great Pyramid of Egypt, by Prof. Piazzi Smyth, has led me to an examination of the proportions and the dimensions of this pyramid, in which I have been assisted by Mr. O'Farrell, of the Ordnance Survey. The result of this examination is curious, if only for showing the simple principles on which the pyramid was constructed, and which have been so strangely overlooked by so many ancient and modern authors who have written on this subject.

First, I find that a pyramid having a square base and a rise at its corners of nine parts in ten, has the exact proportions of the Great Pyramid.

Secondly, that the length of one of the sides of the base of the Great Pyramid is precisely 360 *derahs*, or cubits of Egypt.

This can scarcely be regarded as a mere accidental numerical agreement.

The derah is a land measure still in use, and is stated by Woolhouse, in his "Weights and Measures of all Nations," to be 25·488 inches in length; but 25·488 inches × 360 = 764 feet, which is the exact length of one side of the base of the pyramid, "with the casing stones," as measured by Colonel Howard Vyse.

But the side of the square base being 764 feet, the diagonal is 1,080 feet, the half of which is 540 feet, from which deducting 1-10th, = 54, we have 486 feet for the height of the Great Pyramid; and this is the exact height given by Vyse, and in the diagram which forms the frontispiece to Taylor's work on "The Great Pyramid." For the construction of the Great Pyramid the

* Appendices A, B, C, and D are reprinted from the *Athenæum*.

architect, therefore, had only to set up profiles at the four angles, which had a vertical height of 9 feet or 9 cubits to a horizontal length of 10 feet or 10 cubits, for such profiles would be sufficient to guide the masons at every stage of the work from the base to the apex.

A pyramid with a square base, and a rise in the corners of nine parts in ten, is, therefore, what has been called a π pyramid, its height being equal to the radius of a circle whose circumference is very approximately equal to the length of the four sides of the base.

In the Great Pyramid these dimensions are $486 \times 2 \times 3{\cdot}1416 = 3053{\cdot}6$ feet; $4 \times 764 = 3056$ feet.

In the hope of being able to ascertain the true lengths of the ancient Egyptian measures, I have recently, with the assistance of Commander Bailey, R.N., of the Topographical Staff, and in presence of the very obliging officers of the British Museum, very carefully measured the double royal cubit of 14 palms, which was found at Karnak, and is preserved in the Museum. The length of the digit is 0·739 inches; palm of 4 digits, 2·957 in.; span of 3 palms, 8·871 in.; foot of 4 palms, 11·828 in.; cubit of 6 palms, 17·742 in.; royal cubit of 7 palms, 20·699 in.

The length of the royal cubit was inferred by Sir Isaac Newton from the measurements of the King's chamber and passages of the Great Pyramid, which was taken in 1638–9 by Mr. Greaves, to be so nearly 20·699—(one of his results was 20·700)—that we may feel certain that the interior measurements were set out with a cubit of the exact same length as that of Karnak.

The inference that this is the true length of the royal cubit is confirmed by the fact that the cubits on the nilometer at Elephantine, as given by Sir Gardner Wilkinson, and many others, are virtually of the same length as the royal cubit of Karnak. It would seem also that to get the cubit of the nilometer measured by Le Père = 21·289, they divided the six-palm cubit of Karnak, 17·742 inches, into five parts, six of which parts is equal to Le Père's cubit. So that the graduations of this nilometer are also derived from the Karnak cubit, as well as those of the Elephantine nilometer.

I was much struck with the great accuracy of the divisions on the Karnak measuring-rule, which is much greater than we find in general in the divisions of our own measuring-rules; and I

therefore think the lengths of its several parts, as I have given them, may now be safely adopted as the true lengths of one set of the ancient measures of the Egyptians.

But the measures of the base of the Great Pyramid were set out on the ground with the derah or cubit of 25·488 inches, and Mr. Greaves says he found a cubit in use in Egypt of 21·888, which D'Anville, Grobert, and others found to be as near as possible the length of the cubits of a nilometer measured by them on the island of Rhoda, at Cairo.

The ratio of 25·488 to 21·888 is so nearly that of 7 to 6, or 25·488 to 21·847, that we may safely infer that the derah, or land cubit, is also, like the Karnak cubit, divided into seven palms, and that the nilometer measured by D'Anville and others was graduated from a cubit of six palms of the derah.

That the derah should have been preserved unaltered from the time of the building of the pyramid to the present day is not so much to be wondered at when we remember that, on account of the annual inundation of the Nile, a verification of the land measures was annually necessary.

HENRY JAMES, Col. R.E.

Appendix B.

The Great Pyramid of Egypt.

Ordnance Survey Office,
Southampton, *August* 1, 1868.

In the *Athenæum* of the 16th of November last you were so kind as to insert my note respecting the proportions and dimensions of the Great Pyramid of Egypt, in which I stated, first, that a pyramid having a square base and a rise of nine parts in ten at the corners would have the exact proportions of the Great Pyramid; and, secondly, that the length of one side of the base was 360 derahs, or cubits of Egypt—the length of the derah being, according to Woolhouse, in his "Weights and Measures of all Nations," 25·488 inches. This would make the side of the base equal to 764·64 feet; the measured length by Col. Howard Vyse being 764 feet, and by M. Le Père and Col. Coutell 763·6 feet.

The accuracy of Woolhouse's length of the Egyptian cubit has since been questioned, and this has led me to a further investigation of the dimensions of this pyramid, or I should rather say of the units of measure employed in its design and execution; for we may consider 763·6 feet as the true length from corner to corner of the sockets which were cut into the rock at the four corners of the pyramid, to receive the corner stones. These sockets are 8 inches deep, and the pyramid was surrounded with a pavement of 1 foot 8 inches in depth, by which the length of the sides would be diminished 2 feet 11 inches at each end, and the side of the finished visible pyramid would be reduced from 763·6 to 757·5 feet; and as no one ever designed or spoke of the dimensions of any building but with reference to the work which was visible and finished, we may consider 757·5 as the true length of the side of the base.

Now Herodotus tells us, "Euterpe," 186, that the arura, or Egyptian acre, "contains a square of 100 Egyptian cubits," and I infer that the side of the base was made 500 of these cubits, and that the area of the base was, therefore, exactly 25 aruræ. This would make the Egyptian cubit equal to 1·515 English feet, $500 \times 1{\cdot}515 = 757{\cdot}5$ feet, the length as measured. But 1·515 feet equal 18·18 inches, and 18·181 inches is the length of the Egyptian cubit given in the great work of the French *savants*, "Déscription de l'Egypte," and described by them as the "coudée des Grecs d'Hérodote, juste, médiocre, commune des Arabes, $= 0{\cdot}4618^{m}$"—the Egyptian cubit, according to Herodotus, being equal to that of Samos.

The height of the pyramid above the plane of the pavement was 481 feet. The chambers and passages of the interior were set out with the cubit of 20·699 inches, *i.e.*, of the same length as that of Karnak, which is preserved in the British Museum. The arrangement of the passages was obviously made to facilitate the transport of weights, including the king's body in its case, from the entrance to the centre. The inclination of the ascending passage being made equal to that of the descending, a weight on a truck at the bottom would counterbalance, by means of a rope and pulley, a load descending from the entrance to the point where the passages meet, and be itself drawn up towards the same point, and it would counterbalance the same load when it is being drawn up the ascending passage to the centre, whilst in the same time it

descended to its original position. A very slight amount of mechanical skill would be required to re-establish such a mechanical arrangement for visitors to the interior of the pyramid.

HENRY JAMES, COL. R.E.

APPENDIX C.

The Great Pyramid.

Colonel Sir Henry James, R.E., writing in the *Athenæum* of August 8, proposes a substitute for his previous theory of the base-side length of the Great Pyramid. In his present position accordingly we read:—A. That the slope of the Pyramid extends *beneath* the pavement,—contrary to Col. Howard Vyse, the actual explorer. B. That a difference in depth of 20 + 8 inches, makes a difference in base-length of 2 feet 11 inches at each end,—an arithmetical error in excess, to the extent of 13 inches at each end; or, if the letter in question is to be read as *not* suggesting the addition of the 8 inches to the 20, the arithmetical error must be yet greater. C. That the assumed 2 feet 11 inches off each end would reduce the base from 763·6 to 757·5 feet, a further arithmetical error of a quarter of a foot in excess. D. That the actual depth from surface of pavement to bottom of sockets is 28 inches, whereas it is only about one-third of that depth, this is seen under the next head. E. That "the sockets" (plural) are all at that one level, whereas—according to the only evidence existing on either side of the question—they are not at the same level: those here referred to (the N.E. and N.W.) being respectively 5·8 and 10·0 inches below, and the other two are 0·2 and 19·4.—See "Life and Work at the Great Pyramid," vol. ii., p. 137. With all these extraordinary errors, how can we accept Sir Henry James' expression that 757·5 feet is "*the length as measured?*" It is, therefore, needless to proceed to consider his not reckoning any weight at all to the actual measurement of Col. Howard Vyse, but only to that of the French; or to criticize the claims of the long-subsequent *Greek* cubit, of 18·18 inches, as the ancient base-unit. As to his final idea—for the amusement of visitors to the interior of the Great Pyramid—involving the destruction or removal of the series of huge granite portcullis-blocks and of con-

nected parts which would go with them, at the beginning of the first ascending passage; and (if the mechanical arrangements hinted at were fully carried out) the filling up of the entrance to the Queen's chamber, the laying of a tramway, and minor fixtures;—I leave your readers to characterize the antiquarian taste involved in the suggestion of such treatment to that unique achievement of long pre-historic times,—the most ancient, accurate, and scientific, as well as the *highest* structure known to have been ever reared by human hands.

W. PETRIE.

Appendix D.

Ordnance Survey of Sinai and the Great Pyramid.

Ordnance Survey Office,
Southampton, *November* 23, 1868.

The expedition under Capts. Wilson and Palmer, R.E., arrived at Suez on the 8th inst., and was to camp at Ain Musa on the 11th, on their way to Jebel Musa. The work of the survey has therefore now commenced; and it only remains with the public to say whether, by their contributions to the cost of the survey, it shall be completed. If the party should have time for the purpose, I have instructed the officers to measure and bring home an accurate plan of the Great Pyramid. Strange to say, no accurate plan of this pyramid yet exists. The French *savants* made the length of the side of the Pyramid about 746 feet, and the distance between the sockets at the four corners about 764 feet, agreeing very closely with the measure of Vyse and Perring. These numbers give 9 feet as the breadth of the casing-stones, and therefore the distance from the corners of the Pyramid to the furthest corners of the sockets 12·7 feet—that is, the diagonal of the square of 9 feet. But on the French plan this distance is made about 29·2 feet, or 350 inches—and the Astronomer Royal for Scotland from his "own measures" made it also about 350 inches at each of the four corners. These numbers are utterly irreconcilable; in the one case, the finished Pyramid with its casing-stones would entirely cover the sockets cut in the rock, which are about 12 feet square,—and in the other, it would not

reach to the nearest part of them. Whilst such discrepancies exist it is impossible to say what was the real length of the side of the Pyramid, or the relation of the Pyramid to the sockets. These points I hope will be cleared up by our surveyors; and we shall then have, as I believe for the first time, trustworthy data for discussing the units of measures employed in the design of the Pyramids.

HENRY JAMES, Col. R.E.

Appendix E.

On Cubits.

(1.) *Cubits of Memphis, Samos, and Greece.*

Everyone who has had his attention seriously addressed to the metrology of the ancient world, must have met with Sir Isaac Newton's celebrated "Dissertation on Cubits." Having carefully studied that document, it will surprise anyone acquainted with it to find, that after so laborious an investigation as that which Newton undertook—in which he pointed out, too, with a distinctness not possible of being misunderstood, that the Greek cubit was a different cubit from the Samian, that the latter was nearly equal to the cubit of Memphis, and recognised as an individual and distinct cubit, too—it should at the present day be declared that the Samian meant the Greek cubit; and be further inferred therefrom that the cubit of Memphis was identical with that of the Greeks of 1900 years later date. Yet it is shown in the preceding pages how that has been asserted in the latter third of this nineteenth century.

On behalf of exact science, it is important to contrast this latter assertion with what Newton really has handed down to us thus. He says, "The calculation of the Egyptian cubit is confirmed by the present cubit of the Egyptians used in the city of Grand Cairo, which Mr. Greaves found to be $1\frac{824}{1000}$ of the English foot (*i.e.* 21·808 British inches)."

"This cubit approaches nearer to the antient cubit of Memphis than to the *lesser* (*sic*) *cubits of the Greeks*, Romans, and Arabians who reigned in Egypt, and, therefore, it (that is, the cubit of Cairo

in the time of Greaves, A.D. 1637) seems to be derived from that of Memphis." Again, "The oldest feet of which any account has been transmitted us, are the Roman, Ptolemaic, and the Drusian foot at Tongeren, in Germany, the last of which is equal to 13½ unciæ of the Roman foot. And to these three feet, according to the proportion of 5 to 9 answer the three cubits $1\frac{7406}{10,000}$ of the English foot (20·8872 British inches), $1\frac{8056}{10,000}$ of the English foot (21·6672 British inches), and $1\frac{9582}{10,000}$ of the English foot (23·4984 British inches); and of about these magnitudes are the antient cubits determined by us above, viz., those of Memphis, Babylon, and Persia; *to which add that of Samos, which Herodotus represents as equal to the cubit of Memphis.* The *Greek* and Roman measures *which were secondary measures, adapted to the measures of the feet before received, ought not to come under consideration here.*" These passages are emphatic, and need no comment.

(2.) *The Derah.*

Regarding the derah Newton says, "The derah or Arabian cubit consisted in like manner of 6 palms and 24 digits; and, in my opinion, was very near equal to the Roman or Attic cubit. For it was the fifth part of the Royal cubit of Egypt; that is, four simple cubits of Egypt, which are now equal to five Roman ones."

Of the Roman and Attic cubit, *i.e.*, a cubit composed of one and a half Attic feet, (the Attic foot being the most eminent of Greek feet,) Newton says, "The Roman cubit is therefore $1\frac{4905}{10,000}$ of the English foot (17·406 British inches);" and of the Attic cubit, "that the Attic foot was neither less than the Roman, nor greater than the Roman above a Semiuncia. This being granted, we shall have the magnitude of the Attic cubit to pretty good exactness." This derah value of Newton thus affords a striking contrast with the modern one of Mr. Woolhouse, quoted by Sir Henry James, viz., 25·488 British inches, and with regard to which we may well ask how it has been obtained?

(3.) *Cubits of the Palestine Exploration Association's Map of Jerusalem.*

In 1865 was published the Palestine Exploration Association's Map of Jerusalem, and in order to enable its students to measure

from the map itself, in terms of the sacred cubit, this alleged cubit is printed thereon, and of the length, too, of 20·670 British inches. But is 20·670 British inches the length of the sacred cubit, or even any approximation thereto? Alas, by no means!! For, appealing to Newton again, what do we find him to have concluded two hundred years ago, but that his investigations showed it (the sacred cubit), to be equal to about 24·83 British inches. Newton's own words, indeed, are these—"The sacred cubit is not less than $25\frac{52}{100}$, nor greater than $25\frac{79}{100}$ unciæ of the Roman foot;" and he significantly adds, as before mentioned, "Those who shall hereafter examine the Pyramid, by measuring and comparing together with great accuracy more dimensions of the stones in it, will be able to determine with greater exactness the true measure of the cubit of Memphis, and from thence likewise the sacred cubit."

Under what pretence, then, in the face of the foregoing, is the putting down of 20·67 British inches on the Palestine Exploration map of Jerusalem, as the veritable length of the sacred cubit, justified? Thus, namely, that in 1840, M. Horace Doursther, of Brussels, published his "Dictionnaire Universel des Poids et Mesures, Anciens et Modernes," and in which is to be found, at page 114, the following passage, "La coudée naturelle des anciens Egyptiens (coudée virile—coudée de mesure) représente la distance du coudée à l'extrémité du grand doigt

"(= 17·17 pouces Anglais).

"La coudée royale ou sacrée des Egyptiens appelée aussi coudée du tabernacle, du sanctuaire (*amma hakkodesch*), coudée des vases (*amma chelcelium*) avait un palme de plus que la coudée naturelle—

"(= 20·670 pouces Anglais)."

And a very successful agglomeration of cubits has M. Doursther contrived, if to succeed in so doing was his object; for what he means it is no easy matter to understand. The book from which the quotation is made consists of no less than 604 rather closely printed pages, and of a character more commercial, ordinary, and general than exhaustive, philologic, and scientific; containing, too, an endless quantity of little notes of trade, data collected from all sorts of authors, English, French, and German, of various calibres

and various dates, and none of them very recent, in comparison to the many later printed works and papers on metrology.

As for the "ancient" measures, they are taken from the "Metrologie," by M. Saigez, Paris, 1834, and from MM. Paucton and Romé de L'Isle in the last century, to whose writings and views we have referred at some length in our paper on "Measurements," &c.

M. Doursther, however, appears to have no conception of real ancient Egypt of the Pyramid age; at least, that is our inevitable conclusion, if we are allowed to judge from what he says at p. 114: "Coudée, en Hébreu, *amma*; en Egyptien, *derah*; en Grec, pechus," &c. Now "*derah*" is not ancient or Coptic Egyptian at all, but modern Arabic Egyptian; yet further, at p. 220, under the heading of "Egypte ancienne," he speaks only of the "Philetærian" pound weight, although that is of no remoter age than the Ptolemies; and at p. 408, under "Egypte antiquité," he speaks only of the "Philetærian,"* that is, the Ptolemaic foot.

After what we thus find M. Doursther's Dictionary to really contain, it is no longer a matter of surprise that he has no account of the ancient cubit of the Pyramidal age, or rather over 1900 years earlier than his earliest given measures.

Returning now to the quotation from his (M. Doursther's) page 114, and to the difficulty of comprehending which we previously alluded, it now has to be asked, if that author means that the cubit of 20·670 inches (English) was called among the Egyptians the "cubit of the tabernacle" and the "cubit of the sanctuary?" If so, of what tabernacle and of what sanctuary? and on what ancient authority does he so cite it? Or does he refer to the sacred cubit of the Hebrews, which was called by them the cubit of the tabernacle and of the sanctuary, but which we have elsewhere shown was not 20·670 inches long, but, within narrow limits, 25·025 inches? To answer those queries, M. Doursther says nothing; what he does, therefore, say is valueless, because it is, *first*, imperfect; *secondly*, contradictory; and, *thirdly*, uncertain —as with many another difficult point in a dictionary merely.

An author altogether unreliable and perfectly useless do we, alas! find M. Doursther to be, when dealing with the metrology of the ancient world; yet, in the way that he is trusted to by Sir

* So called, it is believed, after Philetas of Cos, preceptor to Ptolemy Philadelphus, the second Greek king of Egypt, who died about B.C. 290.

Henry James, it is only what we might expect as an exact parallel to his (Sir Henry James') former adoption of Woolhouse for the linear value of the derah; and just as Mr. Woolhouse has been cast aside as unworthy of trust, so is now M. Doursther, who, although quoted openly in 1865 as the author of the 20·670 inch value of the sacred cubit on the Ordnance Map of Jerusalem—where, indeed, it is coupled and made identical with the profane cubits of Egypt and Babylon—is now, *i.e.*, in 1869, passed over altogether unnoticed in "Notes on the Great Pyramid," where the linear value of the sacred cubit declared by Newton, viz., 24·84 inches, is at last given.

Wherefore, then, this great change in the sacred Hebrew cubit from 20·67 to 24·84 inches? Nothing is said about it in the "Notes," but in a letter to the *Daily Review* of October 9, 1869, Sir Henry James says that if he "had not investigated the values of the ancient measures, and corrected those he found wrong, he would have neglected his duty;" which is just as much as to say, that the investigation of the accuracy of the numbers on the said Jerusalem Map, which he had copied from Doursther, was a work of his own imagination, and that it was his own discovery in 1869 that the 20·67 should receive so great an accession as to be printed in future at 24·84; and may perhaps consider that he is not bound to make any mention of what he has borrowed from "mere civilians." Yet the scientific history of this question requires it to be stated, that certain civilian writers on the *sacred theory of the Pyramid* did frequently, between 1865 and 1869, expose the radical error of Doursther and James in making both the profane Egyptian and the sacred Hebrew cubits 20·7 inches nearly, when the latter was more nearly 25·0 inches long; and the public will doubtless form their own ideas as to whether these published criticisms did not lead Sir H. James to investigate and correct his first erroneous numbers.

The following, for instance, is only one paragraph in a paper on the subject, at page 500 of Piazzi Smyth's "Antiquity of Intellectual Man," published in the spring of 1868 :—

"This Ordnance quantity of 20·7 inches (or 20·67 in the scale attached to the Ordnance Survey Map of Jerusalem) is evidently not the sacred cubit at all, but the profane cubit; and in the explanation of the scale at the foot of the above map, the revered names of 'sacred' and 'cubit of the tabernacle' are given to pre-

cisely what Moses was so anxious to keep them from being confounded with, viz., the cubits of idolatrous Egypt and other Gentile nations; the inscription at one end of the Ordnance map scale-lines being, '*Egyptian, Hebrew, Babylonian,*' and at the other end '*Royal or Sacred Cubits, also named Cubit of the Tabernacle.*' If this map is one of those prepared, as believed by some, at the expense, and to the order, of the Palestine Exploration Association, such a radical error with regard to the *sacred cubit of the Hebrews* may well excite surprise. But if, on the contrary, the map is purely the work of the several Ordnance officers whose names are conspicuously engraved upon it, the nation must regret that they should have so entirely ignored the researches of Sir Isaac Newton (in his 'Dissertation on Cubits'), the greatest philosopher their country ever produced, and in one of the most important of all questions that has ever been brought forward in either the science or history of metrical standards."

(4.) *Asiatic Cubits.*

After what has been previously said of "Samian" as equivalent with "Persian" or "Asiatic," it remains a matter of interest as well as importance, to enquire after the dimensions of such cubits from any other sources that may lie open to us, and on this track we are fortunate in having before us the Report of the Astronomer Royal for Scotland to the Edinburgh Observatory Board, dated June 29th of the present year. This document and its appendices are so full and fair on the subject, that any attempt to convey its force and meaning in words of our own would but detract from the masterly style in which Appendix 4 of the said report is written. We therefore conclude this Paper by quoting the Appendix in full, with its notes and addendum by a philological investigator, as follows:—

"Asiatic Cubits, 600 B.C. to 450 B.C.

"The records of Asiatic, do not seem to be by any means so well or abundantly preserved as those of Egyptian, cubits. Indeed I have looked through many modern works on the history, topography, arts, and sciences of the great ancient empires of the Asian East without finding the length of their standard of measure honoured with the smallest notice. In the earlier metrological

works too of modern times, not only is the *foot* standard thrust into the first rank from modern European predilections, but neither to foot, nor to cubit of any peoples, whether Egyptian or Mesopotamian, is a *date* ever attached, nor any certain and absolute significance connected with the expressions 'old, antique,' &c.

"Hence when *certain* writers speak of the *ancient* Egyptian cubit as being 18·2 British inches long (nearly), they are with perfect innocence alluding to the Ptolemean epoch, when a Greek cubit *was* imported into Egypt as well as a Greek ruler, at a date of about 320 B.C. For with *those* writers, everything before the final destruction of the Roman empire by the Goths is "Ancient Egypt;" and the line of the Ptolemies, therefore, something so *exceedingly* antique—that they even give those 'lewd Princes' the honour of having built the Pyramids (every one of which was in reality finished and sealed up more than 1500 years before the first Ptolemy ever set foot on Egyptian soil); and the claim may be seen pleasantly set forth by our greatest poet, Shakespeare. But all these popular errors arising in ignorance of, or depending on contempt for, true and real chronology,—need not in our present proceedings prejudice in the smallest degree what the native Egyptians once did for, and amongst themselves 1900 years earlier with their own religious, albeit idolatrous and profane, cubit of 20·7 British inches long (nearly).

"In the learned and painstaking work, however, of Dr. Brandis of Berlin in 1866 A.D., on the Babylonian measures, weights, and money of, and immediately preceding, the times of Alexander the Great, say 332 B.C. to 600 B.C.,—we evidently touch at once on the system in use throughout the *Persian* empire in its latter days of glory and despotic power; and we are told by the Doctor at p. 21, that the Babylonian ell or cubit varied between 20·866 and 20·670 British inches.

"Don V. V. Queipo also in his Metrology, vol. i., pages 277, 278, and 280 (1859), considers 'that the length of 0·525 m. = 20·670 British inches, which M. Oppert establishes for the length of the Babylonian cubit, was really that of both Persia and Chaldæa' *i.e.* in the later imperial times of those countries, say under Darius and Xerxes.

"At some much earlier date he holds that there was among the Persians a decidedly larger cubit = 25·2 British inches nearly,

which is very similar to what Sir Isaac Newton concluded for an ancient Chaldean cubit, and also for a proto-type of the *sacred* cubit of the Hebrews under Moses, 25 inches long nearly, which he believes the Israelites possessed amongst themselves *before they went down to Egypt.* It reminds also of that symbolical measure of 25·025 British inches, the record or remembrance of an older time, supposed to be typified in the more internal arrangements of the Great Pyramid, such as the niche in the Queen's Chamber, and forming the most appropriate, as well as scientific, earth-commensurable standard that was ever employed by man.

"But the particulars of such a *very* primeval 25 inch standard,—*i.e.*, entirely anterior to 2000 B.C., except as carried downwards among the Hebrew people and their descendants and co-religionists at special periods in their history,—do not in any way belong to the far more modern times which we are now dealing with; viz., those alluded to by Herodotus in 'Euterpe' 168, or 500 B.C., nearly, and to what the Royal Persian cubit, ruling from Thrace in the West to Bactria and India in the East, was *then;* and *that* Persian cubit has been shown by Sir Isaac Newton in his 'Dissertation on cubits' to be probably equal to 20·112; by Dr. Hincks and Dr. Norris as the Babylonian cubit = 20·85, and 21·0 inches; and by Don V. V. Queipo and others to 20·670 British inches.

"Hence the mere list of successive determinations of the cubit of the ruling people throughout Asia, idolatrous also, in the time of Herodotus, runs thus,

	20·866
	20·670
	20·112
	20·850
	21·000
	28·670
Approximate mean for the Persian and Asiatic cubit of about 500 B.C. in British inches (but not the earliest cubic-standard in those countries),	= 20·69 nearly.

"Moreover that Persia did impose its own standards of measure on its subjugated peoples as an early, necessary piece of conformity for them to attend to—we have an instance in Herodotus, Book 6 or Erato, ch. 42, where he records that the Ionian

rebellion under Histiæus was no sooner subdued, than Artaphernes called the deputies of the various Ionian cities together, *and took the measurement of their whole country in parasangs, a Persian measure of length*, and settled thereupon the tributes which the various cities were to pay. *

"* On Cubits so-called. The name of 'cubits,'—perseveringly applied in the present age of the world by our nation to the above-described ancient standard measures of Egypt, Persia, Chaldæa and Palestine; and which, being either 20·7 or 25·0 inches in length, nearly, are far too long to be *cubits* either according to the anatomical reference of the human *fore-arm* (supposed to be alluded to in the word 'cubitus'), or according to the standard of length called *cubitus* by the Romans in their day, and measuring, just as does the human fore-arm from the elbow to the extremity of the middle finger, 18 inches nearly—the name, I say, is not a little unfortunate and misleading to the greater part of the world.

"For such part of the world is only too prone to follow the mere verbal signification, and inclined consequently to shorten those more ancient standards (which flourished among men at least 1500 years before the word *cubitus* was invented in Rome), until it has brought them more into accordance with the fore-arm length of men in the present day; and which length they philosophically believe must also have obtained very nearly as the average of any large numbers of mankind throughout all the periods of human history.

"But strict metrological science cannot give up one jot of the proved material length of those earlier standards to mere philological prejudice of a subsequent age; and we may well therefore enquire by what means the said *longer-than-cubit* standards were known in primeval times among the nations who used them.

"Turning first to that ancient race, well termed by Bunsen 'the monumental people of the earth,' and whose mission was 'to record history and the affairs of men,' viz., the inhabitants of Egypt, we are told by most hieroglyphic scholars (such as Osburn, G. Wilkinson, Birch, and others) that the Egyptian linear standard of 20·7 inches long, was called

'meh,' 'mah,' 'mahi,' or 'mai.'

"Mr. Osburn too particularly relates that the same mode of representation was adhered to from the date of the Great Pyramid

in 2170 B.C., to the times of Diocletian in 290 A.D.; and that its significance was 'justified' or 'measured off.' Other hierologists do not seem so confident on this point and introduce part of a human arm into the hieroglyphic; such part however exhibiting most certainly a portion of the upper, as well as all the lower, or fore, arm; so much so, indeed, that if measured round the elbow corner to its upper extremity, the length would easily amount to 20·7 inches, though to the elbow from the end of the middle finger might only register 18 inches.

"That given, and always duly preserved, proportion, however, of the upper arm added to the fore-arm, would never in any ordinary man amount to 25 inches, *i.e.* the length of the sacred *Hebrew* standard of linear measure. By what name then was that standard known to the Hebrews themselves, though our authorised Bible always translates it confidently as 'cubit?'

"By a word said to have been pronounced 'amma;' and meaning, according to some, 'the *Mother*-measure;' and by others '*prœivit*,' *i.e.*, he or it went before; and which phrase some have asserted *therefore* to imply 'the *fore* part of the arm." Seeing however that the ancient sacred Hebrew standard is so much as a third longer than that anatomical reference, or, in other words, that it is by no manner of means that length—we seem rather to be authorised to fall back upon the 'prœivit' in its more literal signification, and view it—in conjuction with what has already been stated in Appendix 4 on the exceeding antiquity of that standard of measure—as descriptive of what the Hebrew standard did, or at least is believed by many persons to have done, in the early Chaldœan world, viz., that it 'prœivit,' or preceded in point of time all other standards of linear measure amongst men of every land and tongue.

"That 'prœivit' measure, too, or the sacred 'amma,' I may perhaps be excused for reminding, is, as clearly as we have yet been able to determine it, and certainly if assumed equal to 25·025 inches, an even ten-millionth of the length of the Polar semi-axis of the earth, the most appropriate reference for linear measure that the whole globe contains, whether viewed by reason of the rectitude and unity of the line itself, or the large and equal interests which all nations may well feel in its existence.

"Approaching the subject again from the side of the cuneiform inscriptions of Assyrian and Babylonian monuments, we learn from

these well versed scholars therein, H. Fox Talbot, Esq., and Dr. Edwin Norris, that the sound of the word expressing in those countries their cubit measures about the time of Nebuchadnezzar, or say 700 B.C., was generally

'ammat'

occasionally however it was

'hu,'

supposed to be derived from an earlier race of inhabitants in that central land.

"From yet another side some doubt has been thrown upon the word 'amma' having really been in use among the Hebrews before the time of Daniel; for though it is found in Genesis, that is attempted to be explained by the recopying of the Scriptures in the time of Ezrah by Jews largely influenced in their language by the long Babylonian captivity,

"In the absence then of any contemporary material Hebrew document of much earlier time—which, if well preserved and capable of being proved authentic, would settle the controversy beyond all dispute,—I am happy to be able to append the following philological contribution from a gentleman who may ere long publish some further researches into this, hitherto, too little studied, though important, subject alike of scientific and literary antiquity.

(Contributed.)

"1. The only Hebrew word for cubit is אַמָּה 'Am-mâh, a word exceedingly common throughout Scripture.

"2. There is no doubt that the word is connected with אֵם 'Em, Mother, a primitive word manifestly taken from the inarticulate utterances of the child, as our, 'Mama.'

"3. From אֵם proceed a number of words mainly expresssive of family connection. In some cases the idea of 'mother' seems quite lost in that of 'connection' or dependency. This at least is so if אָמָה 'Ā-mâh, a handmaid, is from this root.

"4. Our word אַמָּה Am-mah has in the O. T. probably three distinct meanings—two of which stand in obvious connection with אֵם, mother. (1.) In Isaiah vi. 4, our version has 'post of the door;' it is properly 'the am-mōth' (plural of am-mah) of the thresholds. The meaning is clearly the bases or 'matrices' of the thresholds.

As Delitzsch fairly observes, Am-mah is to Ēm as matrix to mater. (2.) In 2 Sam. viii. 1, we read in E. V. that David took Metheg-Ammah out of the hand of the Philistines. Probably this is wrong. The Hebrew is Metheg-ha-ammah = the bridle of the ammah. On this critics differ. Gesenius, Fürst, &c., render 'the bridle of the metropolis,' which keeps the connection with 'mother.' The meaning is, that David destroyed the autonomy of the Philistines and took the reins of their capital into his own hand. *Cf.* 1 Chron. xviii. 1, which is the parallel passage. Others make ammah here = arm, and Ewald explains 'David took from the Philistines their power to bridle in Israel, as a rider bridles his horse with the rein held fast on his arm.' But Ewald is (I judge from a foot note to this passage of his Geschichte Israels) a little at a loss to see why the hand rather than the arm should not hold the reins! So far then, the relation to אֵם (mother) is clear, and any meaning like *arm* vague and, I judge, improbable.

"5. We pass now to the leading use of the word as a measure. Here I observe—

"*α.* That the lexicographers are agreed that the word must have first meant the forearm, and thence the measure.

"*β.* There is, however, no passage where Am-mah occurs in the sense of forearm; except we must put this sense on it in Deut. iii. 11, 'four cubits—after the cubit of a man.' Literally 'in' [that is *measured in terms of*] 'the cubit of a man.' The construction is a common one, *e.g.* Ex. xxvii. 9, 'a hundred cubits' is literally a hundred in [terms of] the cubit. So that it is even here not so clear that the 'man's cubit' means 'man's forearm.' It may be simply a species of the measure.

"*γ.* The attempts to deduce the meaning 'forearm' from the root אם are various. *Fürst* gets it through the idea of *connection* = The link between hand and body. Alii aliter.

"*δ.* Gesenius in Thesauro gives the following:—He compares *Maltese*, in which omm = mother, omma = trunk of a tree, as *Mater* in Virgil, Georgics ii. 23. Accordingly *he* supposes that Am-mah differs from Em only in being metaphorically used, *i.e.*, of the 'caput origo et fundamentum rei.' Of this general sense he makes it a case that the forearm should be called 'mater brachii.' But why the forearm should be regarded as mater brachii he does not explain. So, as there is no direct proof that the word did in historical times mean the arm, I see no reason why you should not

try to connect the usual meaning as a standard of measure with the notion of a foundation, origin, principle. I don't profess to be clear on this, but, so far as I can see, if you say that Am-mah means the 'fundamental' measure you are keeping quite as close to common sense and the requirements of philology as if you seek a roundabout explanation through the 'Mater Brachii.'

"I should add that Deut. iii. 11 has not the air of being part of Moses' speech. It has the appearance of an antiquarian note of a much later date."

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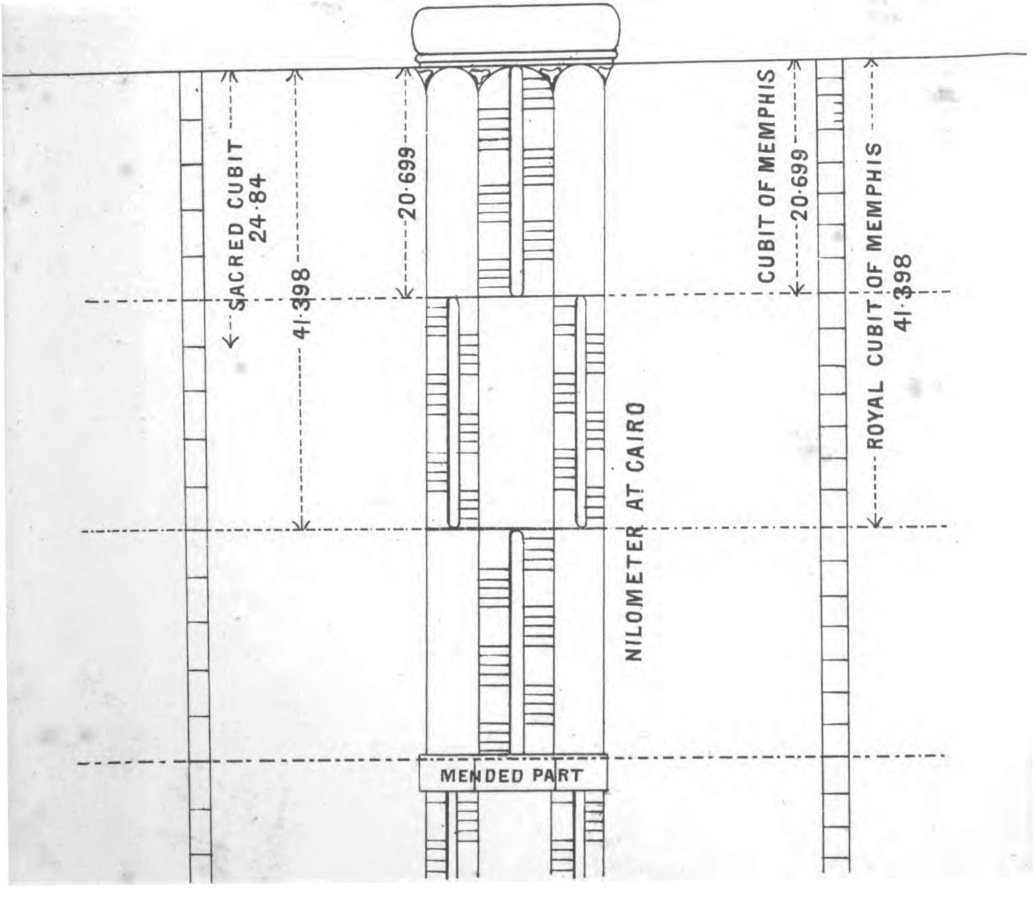

THE NUMBERS ON THE FIGURE INDICATE BRITISH INCHES.