NOTES OF RESEARCH
ON THE NEW YORK OBELISK,
BY ALEXIS A. JULIEN.
PREFACE.

The following reprints of recent papers on the Egyptian Obelisk in Central Park, New York City, are presented in this form, with the special object of interesting you in behalf of the proper completion of this monument—the restoration of its ancient gilding and splendor, as Symbol of the Sun-Beam. The question of its permanent preservation may be considered settled, at least for centuries to come, by the renewal and deepening, during the summer of 1893, of the preservative process (application of melted paraffin) over those spots most injured during the unfortunate exposure of the Obelisk without protection from the weather, from 1884 to 1885. The restorations now proposed consist of two parts.

1. A gilded metallic cap, to cover the upper part of the pyramidion. The Park Commissioners have already placed a zinc cap, coated with a film of gold-leaf, unburnished. This cap is perishable and temporary, and cannot be expected to last but a few years. A cap of some durable metal will then be needed in its place, probably aluminium, well plated with gold and burnished.

2. The re-gilding of the hieroglyphs, so far as they remain distinct, over the lower part of the pyramidion and down the four faces of the shaft. This will require the application of four coats of gold-leaf (not to the whole surface of the Obelisk but only to these characters) and thorough burnishing.

A copper lightning-rod, connecting the metal-cap with the ground, would be also an advisable precaution.

The Obelisk was presented by the Khédives of Egypt as a free gift to the City of New York. It was removed and again re-erected at the expense (over $100,000) of a single liberal citizen, the late Mr. William H. Vanderbilt. We may now naturally look to other citizens of our city to supply the small sum (less than $3,000) yet needed to complete the restoration. New York, however, holds this unique monument virtually as a trust for the whole Western Continent, and, throughout its most remote and wildest regions, this ancient Obelisk is known and its mysterious influence appreciated. From some friend, the gift will come, which will restore the beauty of the once brilliant emblem, and link a second generous name with the most enduring of all human memorials.

Columbia College, Nov. 1, 1893.

A. A. J.
THE MISFORTUNES OF AN OBELISK.

BY ALEXIS A. JULIEN, PH.D.

REPRINT FROM THE BULLETIN OF THE AMERICAN GEOGRAPHICAL SOCIETY FOR MARCH, 1893.
THE MISFORTUNES OF AN OBELISK.*

BY

ALEXIS A. JULIEN, PH.D.

It is not as a traveller that I come before you, but, by proxy, in behalf of a traveller, an aged traveller, who, after a journey of some five thousand miles—carried on somewhat leisurely, in truth, since it covered a trifle over thirty-five centuries—has lately settled down, within our quiet borders, in the hope of a little repose. By a part of our citizens the strange newcomer upon the knoll in our Park, from its arrival in 1881 even until now, has been looked at askance. For wanderers from every clime, there was room within the Park wall:

*LITERATURE.


Clark, E. L. Daleth, or the Homestead of the Nations; Egypt illustrated. Boston, 1864.


for shrubs and flowers of every form and hue; for exquisite carved work in soft freestone, daily rotting into sand; for apes and costly hippopotami; but as for an Obelisk!

I come indeed to plead the cause of a priceless monument in danger, which was put in the keeping


Mayer, Luigi. Views in Egypt, from the original drawings in the possession of Sir Robert Ainslie, with historical observations. London, 1801.


Möddenke, Charles E. The New York Obelisk, Cleopatra's Needle, with a
of New York twelve years ago. If once convinced of the danger, the influence and efforts of the intelligent citizens of New York, and of its responsible officials, will surely be exerted to save the name of our fair city from the certain disrepute, or disgrace, which will follow any neglect of such an accepted trust. The public

preliminary sketch of the history, erection, uses and signification of obelisks. New York, 1891.


Osborn, W., Jr. Antiquities of Egypt, with a notice of those that illustrate the Scripture. London, 1847.


Stuart, Henry Windsor Villiers. The Funeral Tent of an Egyptian Queen, with the latest information regarding other monuments and discoveries. London, 1882.

Valentia, Viscount George Annesley. Voyages and Travels to India, Ceylon, the Red Sea, Abyssinia and Egypt, in the years 1802 to 1806. Three vols. London, 1809.
interest in this monument has not waned, I am sure, outside of this city. A few weeks ago, a friend from a country village, on a hurried visit to New York, wished to be shown first our two surpassing attractions, in his eyes, “the Brooklyn Bridge and the Pyramid.” Of course he was assured that if our merchants undertook to import a pyramid, that pyramid would have to come; but up to this time only an Obelisk had arrived.

With that ancient Egyptian Obelisk, for the last nineteen centuries in Alexandria, which now looms up with surprise in the midst of our modern city, you are all doubtless familiar. You have heard of crumbling decay which threatened its sculptured surface until eight years ago—of the water-proofing process then applied—of the appointment, in 1889, of a Committee of Experts by our Commissioners of the Public Parks, to examine the Obelisk, and their unanimous report that the process had been found so entirely satisfactory in stopping all visible decay over the general surface, that it would be wise to deepen its action in certain cracked spots by a new mode of application, whose details were worked out by a second Committee in July, 1890. Let us then ask to-night, is this ancient relic worth to us the constant attention, watchful care, and a certain amount of expense involved in its protection? Is it of any real value to the City of New York?

I will offer a few thoughts—in part, gathered from the works of Gorringe, Moldenke and others—on the significant idea of the Obelisk, with examples from nature, prehistoric monuments, and early records in Asia and Europe: a brief history of our own peripatetic monolith until it swam over the sea to its present site,
in 1881: our entire neglect of it and its rapid decline, until 1885: and the steps since taken, or left undone, for its protection from our fierce climate.

1. Natural Obelisks. First, consider some strange forms in natural scenery, towering rock shapes, hewn by the lifeless forces which spring from the Sun. Through the very ravages caused by its rays, the Sun becomes a builder, an excavator, a sculptor of wonderful outlines in stone. Here, on some broad plain, as in Colorado, he calls the winds out of the Ocean of Air as his stone-cutters, whirling along the keenedged sand-grains as tools, biting into the cliffs of sandstone or limestone, and scooping them out into curious domes, castles, turrets, and slender spires of rock, like the Cleopatra’s needle in the Garden of the Gods, Colorado—all carved by the force of the Sun. Elsewhere the bosom of the Sea is lashed into billows, which hurl themselves in thundering surf upon the breasts of rocky coasts. * There the Sun-force sculptures walls and piers, arches and lofty columns, such as the Stacks of Duncansoy, in Scotland. Or again, gently and silently, by the trickling rain-drops, which the Sun has lifted high as vapor and then let fall, and by fierce heat of summer rays, and by prying of winter frost, which is but the recoil of a spring long compressed by solar force, the same Patient Sculptor quietly loosens and undermines and picks away a mountain-wall into tall pillar'd forms, like the Cleopatra’s Needle at Devil’s Lake, Wisconsin. All over the earth, great stone fingers are thus left, pointing meaningly upward at the falling darts of the one Vast Force in nature, the blazing orb which has carved out these, the most ancient and stupendous of Sun Obelisks.
2. Prehistoric Obelisks. It is not strange that these weird forms were early imitated by man, especially near rocky coasts along which such natural pillars abound, as those of Brittany. There colossal rude pillars of stone, like those at Carnac (Morbihan),* were set up by prehistoric races, of whose times and of whose very names we have now little or no record. Sometimes these were solitary columns, like the Standing Stones of Dunbar and Lundin Links, in Scotland. Or these were massed in rows which stretched over the land for miles like the menhir of Brittany. Or we find them, perhaps, lifting their heads in clusters, like the lonely groups in Sweden and at Stennis and those among the desolate mountains of the island of Arran, off the west coast of Scotland. Or the same Standing Stones meet our view in the significant arrangement of a ring like the disc of the Sun, such as the so-called Druidical circle at Callernish, on the island of Lewis. Or it may be, in some solitary dell in Asia Minor, there stands a circle, about which the peasants tell the tale of the wrath of an enchanter of old, who, as a wedding party merrily crossed the plain, turned them suddenly into stone; and there they stand—is it sadly or gladly? bride and bridegroom and all—a petrified honeymoon for a thousand years, without a cross word! In most cases, a great stone shaft rises in lonely grandeur in the middle of some broad plain, like the standing stone at Loch Eynert, the primitive form rudely hewn but impressive, of the Obelisk of Prehistoric Time. Its meaning, to the ancient people who set it up, is now but a subject for conjecture. Is it only a fancy, that,

* Miln, op. cit., 199.
gilded or reddened by the blush of dawn, this glittering column of crystalline granite suggested to the human mind, even then, a fitting and cheery emblem of the first beam which shot up from the glorious disc, rising from the horizon, which, from earliest times, as a symbol of Almighty Power, has received the adoration of our race?

That these rude stones were indeed Obelisks appears to be confirmed by the common application of that term to them by early travellers in Scotland, Thos. Pen-
nant, Brand, etc., and by the surviving reverence of the
peasantry toward them, through Saxon and Danish
down to Christian times. A curious example of this
was found in the Obelisk at Ruthwell, a square shaft
about 20 feet in height, and 18 by 16 inches at the bot-
tom, but in three pieces," broken by an order of Gen-
eral Assembly in 1851, under pretence of its being an
object of superstition among the vulgar"*  
3. Prehistoric Tumuli. But often, not far away from
the upright menhir, another low object catches the eye,
which suggests sorrow and loss. It may be a natural
hummock or cone of earth, which tells where the
trunk or stump of some great tree has crumbled away
into dust. It may be a low mound or barrow or cairn,
under which the bones of a slain warrior are entombed.
Or it may swell into a broadly based, conical tumulus,
fifty or even a hundred feet in height, beneath which a
viking lies at rest.

These two are the monuments, roughly shaped, of the
prehistoric races; the one, an upright column of stone,
bright like the sun-ray, suggesting light, birth, life,
hope; the other, a cone-shaped gray mound, speaking
of sadness and death. Sometimes we find even the rude
column surmounting the mound, like the "bauta-stone"
upon the barrow, near Gödestad in Halland.†  
4. Distinction of Stele. We may here, in passing,
refer to the more carefully hewn pillar of early historic
age, which has been often called an obelisk, by Raw-
linson and others, but is better distinguished by the
Greek name of stela—an upright rectangular slab with
rounded summit, such as the stela of black basalt from Nimrud* in Assyria, set up, it may be, as a record of victory, for an epitaph, or as a kind of monumental placard. Such too is the Assyrian stela of black marble, erected by Shalmaneser II., covered with figures in triumphant procession. Sometimes it became dedicated to the king of the nation, vicegerent of the deity upon earth, like the stela, adorned with the sculptured form of King Samas-Vul II. of Assyria: a record, as Defoe puts it, of "the divine right to govern wrong." The most ancient example known is perhaps the round topped stela of Begig, in the Fayoum, Lower Egypt, erected.

* Rawlinson, Five Great Monarchies, II., 266.
by Osirnasen I., 45 centuries ago. One of the least known, and of undetermined origin, is the lofty stela discovered by Viscount Valentia, in 1806, at Axum, in Abyssinia, a granite monolith, 80 feet in height.* Other pillars stand, as solitary decorations, in the middle of courts of ancient palaces, like the Assyrian stela in the palace at Khorsabad,† the half-sunken, shrine-crowned pillar of Cashmere, the serpent column of Constantinople, or the great column of wrought iron at Delhi, the Masjíd-I-Kutb-ul-Islámi, now over twenty feet in height, whose lower part is buried in the soil to at least the depth of forty feet.‡ Others have been raised as memorial monuments to great and beloved citizens, like the curious triangular pillar of white marble, to C. Cassius Philiscus, found by an old traveller, at Nice, in Asia Minor.§ On a smaller scale, in modern times, the obeliscoid form has been commonly devoted to the honor of the dead, like that which stands on a knoll in Rockland Cemetery, where lies asleep he who brought over to us our Obelisk from Alexandria, Lt. Commander Gorringe.

All these stelae, however, with the upright tablets raised for more commonplace uses, to mark boundaries, goal-posts, mile-stones, etc., have been but secondary forms of use, examples of divergence, to lower objects, from the prominent design of upright stone monoliths in prehistoric times.

Even by the sun-loving Assyrian and Greek, the
noble thought of the Egyptian seems to have been imperfectly understood. The Greek amused himself by applying, to the slender pointed shaft of the Nile valley, the nickname, ὀβελίσκος (a little skewer or spit); but, like many another nickname, this has become a designation of honor.

In Egypt, from the very beginning, the Obelisk was adopted as the symbol of a lovely thought—the pledge of the sunbeam as a gift of life and coming immortality from a Kindly Power, a message of dedication to the symbol of that Power, the most majestic object in nature—(as Whitman calls it) "the splendid silent Sun!" This continues to be to us too, of the Nineteenth Century A.D., of the most fascinating interest, since we definitely know that, from that vast source of light and force come the sigh of every breeze, the roar of the gale, both ripple and storm billow of ocean, every thrill of nerve and swell of muscle, every stroke of wing or fin, every form and phase of life, voice, thought, existence itself!

5. The Sun in Egyptian Mythology. This view of the all important relationship of the Sun to man is no novel conception of our own time, science or theology. You will allow me to review briefly some well established facts. The men of earliest history, nowhere more clearly than on the sunny banks of the Nile, felt the same dependence on that brilliant fountain of life and light and joy. Listen to a part of the prayer of Queen Nefer-i-Thi, in the year 1466 B.C.

"Thou Disc of the Sun, Thou Living God! There is none other beside Thee! Thou givest health to the eyes through Thy beams, Creator of all beings. Thou
goest up on the eastern horizon of the heaven, to disperse life to all which Thou hast created: to man, four-footed beasts, birds, and all manner of creeping things on the earth, where they live. Thus they behold Thee, and they go to sleep when Thou goest down. Grant to Thy Son who loves Thee, life in truth: to the Lord of the land, that He may live united with Thee in eternity."

At the basis of all ancient faiths, the single visible Sun became the natural symbol of the Single Invisible Deity, Amen-Ra, the Hidden One, King of the Gods, with the life symbol in His right hand. All other superior gods of Egypt were but emanations from Himself, and in all cases assumed the addition Ra to their proper names. Thus the Divine vengeance was indicated as another deity with head of crocodile, Sevek-Ra: the Divine spirit, Knum-Ra: the Creative energy, Khepe-ra: the height and depth and omniscience of the Divine Mind, as the hawk-headed Sun-God of Morning and High Noon, Ra or Phre of Memphis, with the head of the bird of loftiest flight in Egypt, the sparrow hawk (like our own eagle), with its keen sight, and soaring and plunging course through the air. All the gods were gods of the Sun.

But with the Sun's daily passing to and fro, and the cheering or depressing effect of his reappearing and disappearing on men's hearts, another phase of the worship of Ra was connected. At the sun-setting, gilding the placid bosom of the Nile, they looked sadly, as at the departure of a friend, but with hope for his speedy return. Sunrise they hailed as fulfilment of their hope, while the hateful darkness fled away. So in the holy

*Brugsch, op. cit., I., 450.
City of the Sun, An or Heliopolis, in Lower Egypt, with the first flight of the sparrow-hawk at dawn arose the glad hymn to Ra-Hor-Khuti, the Rising Sun, the Guardian of the Upper World. At eve, the solemn chant floated over the river to Atum-Ra, or Tum, the Setting Sun, just about starting westward under the stars of night, on his dangerous voyage through the Lower World, till, in the East, the morning came again. In this cloudless Nile-land, bathed in never ending sunlight, we find a cheerful and contented people, to whom life was a delight and but too short, the earth a glad-some place they were loath to leave. What wonder they paid their vows to the visible symbol of Ra, whose every ray bore in a friendly hand the gift of life to King and Queen and to all their people. Their deepest hope lay in its renewal and eternal continuance, and therefore in the preservation of their bodies for the coming resurrection of Osiris. For their worship was that of the Sunbeam—the token of all that was brightest in human life and hope.

6. Obelisk and Pyramid. What more fitting emblem of this idea could the Egyptian set up—what more worthy of our sympathy and reverence—than the Obelisk—a towering shaft of ruddy stone, like the first beam of rosy light which flashes up from the daybreak? This too is the birth, the first suggestion of the Cathedrall Spire. Out under the open sky, therefore, should the old monolith fitly stand for all time, to tell us this story.

While the Obelisk thus sprang up significantly on the east side of the Nile—such as that of An—on the side of the Rising Sun, far away to the west, however, and
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only there, amid rock-cut cemeteries and subterranean sepulchres, you see the Pyramid, solitary and independent, the solemn emblem of the Sun after its Setting, the midnight Sun of the under-world, the type of death and darkness and the grave, enclosing the mummy of some mighty king. We find here the same contrast as in the prehistoric monuments: the Standing Stone or Menhir has developed into the more shapely hewn and polished Obelisk: the burial Tumulus, the Pyramid. And yet, to the Egyptian mind, Life and Death, they are but one; on the summit of the Obelisk is the sacred crown, the Ben-ben or pyramidion. In fact, like the "bauta-stone" on the tumulus, there are very early instances of an obelisk surmounting a pyramid.

7. Origin of the Obelisk in Egypt. A link yet remains missing in the chain of my argument. If both menhir and hewn column have sprung from an idea first suggested by natural, sun-carved rock-needles, scattered over the face of the earth, where in the Nile Valley did the home-loving Egyptian first catch the suggestion of the Obelisk? I would submit to your consideration, that this locality, this birth-place of the obelisk idea in Egypt, was at its extreme southern boundary, under the line of the Tropic, on the Nubia frontier. There on the upper Nile, stood the old city of Sun-t, "allowing the entrance" (as the Egyptian called it), Syéné (the Greeks), or Assouan (the present Arabs). Farther north was the site of Thebes, with the temples of Karnak and Luxor, 136 miles below. Still farther down the Nile, we now see Cairo, with the pyramids of Gizeh and the site of An, 560 miles below; and there, Alexandria, on the sea-coast, over 700 miles below.
At Sun-t, a vast rib of red hornblendic granite, (much like our red Nova Scotia granite), juts out from the desolate ranges of the Libyan desert in a belt of remarkably wild and picturesque scenery; in crossing the Nile, it breaks it up into the famous First Cataract. From the earliest ages and in classic times, as the writings of Seneca and Cicero record, this rugged region had a frightful renown, particularly from the reports of the terrible roar of the waterfall, by which all the inhabitants for miles around were made as deaf as the stones themselves. It was famed also for its "shadowless well," and the locality where, at noon, on the longest day of the year, you might look down at your feet and find that you cast no shadow.

As late as 1714 A.D. came the traveller, Paul Lucas, who, in accounts of former voyages, had announced to the geographers of Europe that, with his own eyes, he had seen giants leaping up the peaks of Thessaly like the steps of a staircase: one-legged men who ran with amazing swiftness: and, at an interview in the desert, the hermetic philosopher Nicolas Flamel and his wife Pernelle, although certainly three centuries after their death.* After his return home from his visit to Syené, he gravely related to Louis XIV. that the waterfalls there fell at several places from a mountain over 200 feet in height, with one sheet thirty feet wide, behind which visitors might pass without wetting themselves; he also repeated the marvellous story of the Land of the Deaf; all of which, with the deference properly due to a man of science, was swallowed by the Grand Monarque.

The travellers who have succeeded him, however,

* Champollion-Figeac, op. cit., article "Syene."
unite in enthusiast c description of the wild grandeur of the scenery along the river, in ascending the cataract, mainly due to the vertical clefts which seam the granite walls, as in the well-known rock of Abousir. In the year 1802, the traveller Denon, with the great French Expedition under Napoleon, vividly describes the scenery near the First Cataract, and gives a view, in the desert, of the picturesque Two Mountains, the Djebel el, in which the columnar structure of the granite, throughout this region, is well shown. The sketches of Gau* also illustrate the same vertical fissures, in his views around the First Cataract and farther up, toward the Nubian boundary. Freeman has already observed: "The birthplace of Egyptian architecture is certainly to be looked for in the rock excavations of Nubia, which stretch from the frontier of Egypt as far as the ancient Meroë." †

Concerning this upper part of the Nile, Villiers Stuart writes: "We left pretty Maratta behind us, borne quickly along by the seething waters, and were presently amidst the castellated piles of granite boulders, so well known to all who have visited Nubia."

It is now that we approach the point, after ascending the Nile above the First Cataract, about nine miles above Syenë, the island of Aareq't, "the island of ceasing," or Phile, of which Stuart says: "Just above the cataract, at a point where the Nile takes its course through enormous piles of black granite boulders, its romantic temples and palm groves lie imbedded like a fairy scene amid the surrounding desolation." ‡

* Gau, op. cit., Pl. I.
† Hist. of Arch., 81.
‡ Stuart, Nile Gleanings, 201.
This was, you will remember, to the ancient world, the most astonishing spot upon the surface of the earth: a fitting place, as we might anticipate, for the birth of one of the world's wonders. To the Egyptian, this region of almost unearthly wildness, was the burial place of Osiris, the true Source of the Nile, the natural holy shrine of Isis herself, for pilgrimage of king, philosopher and priest: where no Egyptian offered to go without express and rare permission, over which no bird dared to fly, by which no fish ventured to swim.

Here, in 1743, came a reliable English traveller, who gives this description: "The rocks here are very high, on which the antient Syené was built. . . . Some of them are in the manner Strabo describes: a rock standing up like a pillar, and a large rock on it, hieroglyphics being cut on some of them. . . . Returning I took a view" (i.e., made a rough sketch) "of some extraordinary high rocks in a regular figure, as represented in the 50th plate; on them are cut hieroglyphical inscriptions and figures of men and they directly face the north end of the isle."* In the year 1755, the place was visited by a Captain of the Danish navy, and he gives us a view of the same Island of Philæ, from the upper end of the Cataract, with a better drawing of the same lofty mass of columnar rocks, represented on the right.† In his travels, in 1863, Mr. Hoskins observes concerning Philæ: "Few views in the world can rival the one from this, the west side of the great Temple. There may be finer granite rocks in other lands, but where will you find them equally bold and

* Pococke, op. cit., I., 121.
† Norden, op. cit., Atlas, Pl. CXXXVI.
picturesque in their form? Rhomboidal masses, piled one upon another, some of them looking as if they only wanted a wind strong enough to hurl them into the river, combined with palm and acacia trees. . . . To the right, are three picturesque columnar rocks, covered with tablets of hieroglyphics."* This remarkable column I illustrate from an old drawing;† Again, Bartlett gives us a picture of the approach to Philæ from the north, including the same lofty granite column, on the right. Through all these drawings rough sketches or, it may be, somewhat idealized, the same prominent feature is constantly shown. Such a view is better than a photograph, in one respect; for we need to be impressionists, for our present purpose, and, from the influence of this scenery on modern travellers, form some idea of that produced on the still more impressive mind of the ancient Egyptian. The same wonder and enthusiasm are expressed by the late Miss Amelia B. Edwards, in her description of the view from Philæ:

"Perhaps the most entirely curious and unaccustomed features in all this scene are the mountains. . . . Other mountains are homogeneous and thrust themselves up from below in masses suggestive of primitive disruption and upheaval. These seem to lie upon the surface, foundationless; rock loosely piled on rock, boulder on boulder; like stupendous cairns, the work of demi-gods and giants. Here and there, on shelf or summit, a huge rounded mass, many tons in weight, hangs poised capriciously. . . . But the most amazing of all is a natural monolith on the east

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* Hoskins, op. cit., 205.
† Champollion-Figeac, op. cit., Pl. 75.
bank, down by the water's edge opposite, near the carob-trees and the ferry. . . . Though but a sin-
gle block of orange-red granite, it looks like three; and the Arabs, seeing in it some fancied resemblance to an arm-chair, call it 'Pharaoh's Throne.' Rounded and polished by primeval floods, and emblazoned with royal
cartouches of extraordinary size, it seems to have attracted the attention of pilgrims in all ages. Kings, conquerors, priests, travellers have covered it with records of victories, of religious festivals, of prayers and offerings and acts of adoration. Some of these are older by a thousand years, and more, than the temples on the island opposite."* Here, therefore, at Philæ, I think, was the birth-place of the very idea of the Obelisk. To this huge natural shaft, Pharaoh's Throne, and the numberless upright pillars of granite which loomed up around and above the First Cataract, the Egyptian mind probably owed its first impression of that which was to become an imposing feature of the national architecture.

8. Granite Quarries at Syené. The invariable source of the material for the obelisks was found very early in excavations a little below the Cataract at Sun-t or Syené, which developed into the famous quarries, probably the most ancient in the world. These yielded the bright colored and durable stone suitable for a representation of the sunbeam, the rose-colored granite, "machet" or "heart-stone," as the Egyptians called it. With chisels of copper, and perhaps of iron, and copper saws fed with sand or corundum, the old quarrymen managed to cut long series of shallow holes along every quarry-face, now left as rows of wedge-marks along the ledges. In these holes, some think, wooden wedges were tightly driven, whose swelling, after wetting with water, caused the splitting away of the selected block. According to another view metal wedges were inserted in the holes, as now in our own

*Edwards, op. cit., 231.
quarries, whose continuous beating from one end
toward the other, at one time, by great gangs of work-
men, caused the stone to part.

You are probably aware, through the public journals,
that the State of Wisconsin has just flung defiance to
Ancient Egypt in the production, for the Columbian
Exposition at Chicago, of a monolith obelisk, 115 feet
high, 10 by 10 feet at the base, and 4 by 4 at the top.
This is indeed 91 feet taller than the Lateran obelisk
at Rome, the highest Egyptian obelisk which happens
now to be standing. With five steam channellers, it
was cut out, at the Prentice Brown-stone Quarries, in
three months and a half, all but the loosening of the
bottom of the stone from its bed. This was accom-
plished by wedges, and is thus described:

"For this work wedges had been entered, and all
that remained to be done was to drive them, upon a
given signal, until the rock was wholly separated. Fifty
men were carefully selected for this work, and with
mauls raised, on November 18, they waited for the
signal.

"The word was given at 11 o'clock by President Prent-
ce, of the Prentice Brown-stone Company, who
donates the stone to the State of Wisconsin. At the
sound of his voice the mauls descended. As each man
struck a wedge he stepped forward, from the base to
the apex, striking a wedge at each step. The men
kept step like soldiers, and the fifty mauls descended
as though wielded by one man. The first crack ap-
peared at the base. It gradually widened and spread
as the blows continued to descend, until, at last, the
entire shaft separated from the ledge. There was a
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slight tremble at the moment of complete parting, and there lay the great monolith."

But this stone is, after all, but brown-stone, not granite, and it is simply to be dressed before it is borne to Chicago, in place of the elaborate sculpture in hieroglyphics, polishing and gilding which the intensely hard granite obelisks of Egypt received. The enormous unfinished obelisk, 95 feet long, with a base 11 feet square, which still lies in one of the old quarries of Syéné, is over 400,000 pounds heavier than the monolith of the Wild West; it is roughly hewn on three sides, but underneath yet undetached from the rock.

We may gladly remember that there are no associations of oppression or sorrow connected with the construction of the obelisks. It required the most skilled, and therefore willing labor. The words of one thorough Egyptologist, in regard to another class of monuments, may here be recalled:

"It was not an enfeebled race of captives who built the pyramids, groaning under the lash as they toiled, but a youthful and vigorous nation, who, during long centuries of peaceful inactivity, spent their superfluous energy in joyful labor, to accomplish an almost superhuman task, under the very eyes of princes whom they reverenced as divine." *

There is no evidence that the hand of a slave ever rested upon our own Obelisk, except, it may be, in later times, as an emblem of hope and coming deliverance.

9. Various Egyptian Obelisks. In regard to the antiquity of the obelisk, there is one record, now nearly

* Ebers, op. cit., I., 139.
5000 years old, showing the obelisk of Khufu, with its attendant priest, in the Fourth dynasty, sixteen centuries before the quarrying of our own obelisk began. In many very old hieroglyphic inscriptions, the symbol of the obelisk (tekhen) stands among the characters, in one inscription within a pyramid. The figures of a pair of obelisks remain sharply cut on two faces of the London Obelisk; and a corresponding pair is recognized, half-effaced, by Dr. Moldenke, on the south side of the New York Obelisk. A similar representation of a pair of obelisks was also found by him on a piece of mummy cloth, a fragment of the Ritual of the Dead.*

The oldest obelisk of all, of the IVth or Vth dynasty, about 3000 B.C., was little more than a model, as it was but a little over two feet in height; it was found inside of a tomb at Thebes by Lepsius, and is now in the Berlin Museum. Stuart also has described two others of a small size and simple form, found at Deah Abou'L Neggah, near Thebes, with inscriptions of King Entef of the Eleventh dynasty, about 2400 B.C. But, with these exceptions, all the obelisks occur on the east or morning side of the Nile, where they once stood, always in pairs, before the gates of some temple. However, according to Ebers, small obelisks bearing the name of the owner were sometimes to be seen near the gates of the Egyptian country-houses.”† We owe to Chipiez an imagined restoration of the approach to the Temple of Luxor, which gives some idea of their original position among the flying standards, and of their imposing effect at the end of the long double line of huge

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* Moldenke, op. cit., 33.
† Egyptian Queen, Tr. by E. Grove, I. 7.
sphinxes. Those at Luxor were erected by Rameses the Great and his fair queen, Nofre-Tari, about 1360 B.C., and the most perfectly executed of all existing obelisks; so sharply were the hieroglyphics cut, and to such depth (2 inches), that the Arabs managed to mount by inserting their toes. The one on the left, the east, still remains there, but that on the west was taken down by the French, carried to Paris, and there erected in 1836 on the Place de la Concorde, a shaft about 75 feet in height. This western obelisk is shown in the illustration as it stood at Luxor,* upon its original pedestal; this base, however, was left behind by the French, and remains buried.

Forty obelisks of Egypt have survived, down to our day, out of the hundreds which once adorned her temples and palaces. All these are more or less mutilated, only nine now standing in Egypt, ten fallen and broken, and the greater part carried away to foreign lands. In Rome there are nine of Egyptian origin, of which seven probably belonged to the glittering company which once shot up, near the New York Obelisk, in the City of An, viz.:

Campensis Obelisk, on the Monte Citorio, erected by Psametik II. at An, now in five pieces and with most of its hieroglyphs effaced, 71 feet and 5 inches in height.

Flaminian Obelisk, on the Piazza del Popolo, erected by Seti I. at An, now in several pieces, 78½ feet in height.

Mahutean Obelisk, before the Pantheon, erected by

* D'Avennes, *op. cit.*, I., last plate.
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Rameses II. at 1/2 An, with its lower part broken off, and now 20 feet in height.

Vatican Obelisk, on the Piazza di San Pietro, once erected at An, perhaps by Menepthah I., the largest entire obelisk out of Egypt, 83 feet and 1/4 inches in height.
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Sta. Maria Maggiore Obelisk, probably erected originally at An, without inscriptions, 48 feet and 5 inches in height.

Monte Cavallo Obelisk, before the Quirinal, once probably erected at An, without inscriptions, 45 feet in height.

To the above, some authorities also add:

Lateran Obelisk, in front of Church of San Giovanni in Laterano, perhaps erected originally at An, by Thothmes IV., broken in two and re-cemented, the loftiest of all erect obelisks, 105½ feet in height.

Besides these, there are elsewhere, of the same glorious company:

Atmeidan Obelisk, in Constantinople, erected by Thothmes III. at An, the lower part broken off, and now 55 feet and 4 inches in height.

Boboli Gardens Obelisk, in Florence, Italy, erected probably by Rameses II. at An, 16 feet and 1 inch in height.

Alexandrian Obelisk, in London, erected by Thothmeses III. at An, as companion to the New York Obelisk, with hieroglyphs largely obliterated on three sides, 68 feet and 5¼ inches in height.

Cleopatra's Needle, in New York, erected by Thothmeses III. at An, with hieroglyphs badly defaced or obliterated around the bottom and up two sides, 69½ feet in height; By its original granite pedestal and limestone base, the height of this monument is increased to nearly 80 feet above the pavement.

A significant fact is found in the fractures, defacement and mutilation shown in nearly all the obelisks which
once stood at An, in comparison with the general preservation or perfection of those at Thebes.

It is but the story of our New York Obelisk that we can now briefly review: as you will see, a record of repeated misfortunes, in the shifting changes of Egyptian—but, we will hope, not of American—politics. Again and again it has been threatened with, and just escaped, the destruction which overwhelmed its companions. But its last, its recent calamity, was the most dangerous of all.

10. Conveyance of Obelisk from Syene. With several others (probably three) this monolith was hewn out at Syene in the Eighteenth dynasty, the most glorious period of Egyptian history. Thence the sprightly company of youthful obelisks started on their journey down the Nile valley, for almost 600 miles, to the city of An. As to the mode of conveyance of such huge masses of stone, there is some uncertainty, no picture nor inscription having been found with any direct bearing on this subject. The fitness of the Nile as the medium of transportation is at once suggested; but of this there is no record. The position of all the great obelisks on the same side of the Nile, the eastern, as that on which the quarries stand, is but a proof, in the opinion of some authors, of the ancient necessity of conveyance of these heavy masses by land, rather than of any choice from a religious point of view.* The only picture extant, having any bearing on the matter, is that from the tomb in El Bersheh, which represents a colossal statue dragged along upon a sledge by main strength, with the labor of several hundred men, while

* Stuart, Nile Gleanings, 213.
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a few in front pour a liquid over the road-bed, possibly oil, more probably water, to dampen the chafing ropes * or to harden the sand and facilitate the dragging.†

In the approach to the quarries of Syenē from the north, Denon states: "In the afternoon I found, in the middle of the desert, the trace of a grand antique road, bordered with large masses of cut stone, which led in a straight line to Syenē."‡

An ancient historian also records§ that, in one case, it required the labor of a couple of thousand men, three years, to transport a huge monolithic chamber to Sais in the Delta. You recall also the tale of Pliny, how an early King, Rhamessesis (probably Rameses II.) brought down an obelisk to the city of An, by the exertions of 120,000 men, and then bound his own son to the summit of the shaft, during its erection, so that the officials might not neglect any care. The first instance of the removal of Egyptian obelisks to a foreign land occurred 664 B. C., when Assurbanipal, with his Assyrian hosts, ravaged Thebes and carried two obelisks to his palace at Nineveh, evidently as far as the Red Sea overland; these were ultimately destroyed, with Nineveh itself, by the Medes, 606 B.C.‖

But, in addition to this method, it is highly probable that the Egyptians were accustomed to float obelisks, colossi and huge blocks down the Nile in barges or rafts, during its inundations. It is recorded that they had vessels sometimes 120 feet in length, and others are re-

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* Parker, op. cit., Thos. L. Donaldson, 35.
† Compare Champollion-le-Jeune, op. cit., IV., Plate ccclxxxix.
‡ Travels, II., 68.
§ Herodotus, II., 175.
‖ Records of the Past, VI. Cooper, op. cit., 18.
ported of 420 feet. Under the Sixth dynasty, Una, a governor, thus describes his conveyance of stones for a pyramid: "I made first a boat of burthen, 60 cubits long and 30 cubits broad," 110 by 55 feet; "as soon as the water rose, I loaded the rafts with immense pieces of granite for the pyramid."*

The Chief Architect under Amenhotep VI. states concerning the transport of colossal statues of that King: "I caused eight rafts to be built; the statues were carried on the river."

Much later, 380 B.C., according to Pliny,† Nectanebo, of the Thirtieth dynasty, cut out an obelisk from the quarry, 80 cubits long (140 feet), which Ptolemy Philadelphus afterward floated on a raft down the Nile and through a canal, and erected in the Arsinoite Nome, near Alexandria.‡

But I think that I have found other circumstantial evidence to the same effect, in the records of the Eighteenth dynasty. The inscription § (quoted in full beyond) on one of the obelisks of Queen Hatasu at Karnak states:

"Her Majesty began the work in the fifteenth year of her reign, the first day of the month Mechir, of the sixteenth year, and finished it on the last day of the month Mesore, making seven months from its commencement in the quarry." On this Cooper remarks, "the month Mechir began about 17th December, and Mesore about the 15th of June," and there he stops. But it happens that on the 17th of June falls the "night of the

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* Brugsch, op. cit., I., 425.
§ Cooper, op. cit., 32.
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drop," Leila-en-mekta, as the Arabs still call it at Cairo, the momentous night when, according to a dainty conceit of the ancient Egyptians, the mother goddess, Isis, ever lamenting for her slain husband (Osiris), let fall "the divine tear," somewhere upon the upper Nile—and the Nile began to rise! Certain it is that the rise of the eagerly watched sacred river, hardly perceptible at the beginning of June, suddenly every year becomes strongly marked between June 15th and June 20th. So the rush of the work upon the Queen's obelisks to their completion upon exactly that date hardly looks as a mere coincidence, but rather as a sign of carefully planned dispatch, that the obelisks might be ready for the rise of the river, and therefore that their transport was to be effected by floating down the stream. As Queen Hatasu was the sister, the predecessor on the throne, and, for a time, the co-regent of Thothmeses III., an equally energetic monarch, it is probable that his obelisks also—i.e., at least, the New York, London and Constantinople obelisks—were both fashioned and conveyed to the Delta in a very short time, probably therefore on the bosom of the Nile.

We have next to consider certain rulers of Egypt, whose history, with long intervening intervals, is more or less blended with that of our Obelisk, and, in part, inscribed upon its faces. Of these there are five, so that our monolith might well be styled the Obelisk of the Five Kings.

11. The Kingly Builder, Thothmeses III. Our Obelisk was brought down to An at the command of the Pharaoh Dehuti-mes III. (in Greek, Thothmes, or Thothmeses), and in the early part of his reign, about
the year 1585 B.C. This great and warlike monarch has been styled the Alexander the Great of Egyptian history, the empire, during his reign, having been extended over the whole known world. At the same time, he was one of the great scholars of his kingdom. His very name, Thothmeses, signified "offspring of Thoth," the god of learning and sciences; in the library of the palace at Amada, he is pictured, standing before Sefekh, the goddess of writings and history. During his active life, he erected many temples and palaces, adorned with obelisks, at An and Memphis and Thebes. The portrait of the Royal Builder of our Obelisk was therefore of as much interest to his subjects as to us, constantly represented by brush of painter and tool of sculptor. He received the epithet, Mai-Re, Beloved of the Sun. His name was held in such high veneration that it is found inscribed on large numbers of scarabs and amulets, and on one he is represented worshipping the Sun-Ray, the Obelisk.*

Any object bearing his name, it was positively known, would bring great good luck to the possessor. So mote it be to our fair city of New York! For down the centre of each face of our Obelisk, nearly 3,500 years ago, the King had written, with the usual modesty of kings, his title and his great name, and there they are to this day! During fifty-four years, this mighty monarch, Thothmeses III., ruled over Egypt, and, at his death, was entombed with royal honors, in the Valley of the Kings, near Thebes, for his long sleep, to wait for the call of Osiris. But neither for the body of the King, nor for the obelisks he planted in An, was there to be

* Parker, op. cit.
rest. As the obelisks, at a later period, were carried away to another site, at Alexandria, so there came rude disturbance to the sleeping King. In some time of invasion or danger, the faithful Theban priests came to the valley by night, lifted all the coffins of kings and princes out of their stone sarcophagi, bore them over the hills to a wild gorge, Deir-El-Bahari, and there, in the darkness, piled them up hastily in a cavern they had secretly excavated, and covered up its stone portal under a vast heap of sand. The position of this mass of sand, lying so far up on the hillside, excited the suspicion of a wandering Arab in 1879. It is a strange coincidence that, just at the time, in 1880 and 1881, when the Obelisk of Thothmeses was again overthrown, to be carried from Egypt over the ocean to New York, the King’s resting place was rediscovered and again violated, and the mummy of the Kingly Builder of our Obelisk was for the third time borne away and deposited in the Museum at Cairo. By its side, wrapped tightly in swaddling bands, the paddle was seen, wherewith, in Paradise, the risen Thothmeses might guide his boat over the Sea of Joy. And the mummy was unrolled, and the King’s face uncovered, and his right hand, clasping, over the hollow where his heart had been, the King’s greatest treasure, not a crown-jewel but a stone scarab, emblem of his hope of resurrection and immortality. Even of that emblem, it was found, he had been already robbed by some Arab, through an opening cleft through the mummy. There was but just time to take a hasty and imperfect photograph, and then, before the bystanders and to the dismay and despair of the Director of the Museum, “the features
crumbled to pieces and vanished like an apparition, and so passed away from human view forever.” Yet a wreath of flowers which had been wound around the body by loving hands, before the burial, was found so wonderfully preserved, that even their colors could be distinguished, and they looked as if only recently dried; while a wasp, which, tempted by the flowers, had flown into the coffin before it was closed, thirty-five centuries ago, was found dried up but still perfect, having lasted better than the King.* And this was the last of Earth to Thothmeses.

12. The Architect of our Obelisk. Another question of interest is, who was the architect that planned and supervised the erection of our Obelisk? The names are on record of a large number, at least forty, of the great architects of that wonderful land. The glory of Egypt was her architecture, and, as historians recount her architects were held in royal honor. Nearly all were married to daughters or granddaughters of the reigning Pharaoh. One family of successive architects has been studied, reaching from the reign of Seti I. to that of Darius, from father to son for twenty-two generations.† Statues were often erected in their honor, such as that of the great architect of Memphis, Ra-Nefer, which was dug up near Cairo.

We fortunately know at least the name of the illustrious architect who erected, at the city of An, the temples and palaces of Thothmeses III., with their decorations, doubtless including our own New York Obelisk.

*Stuart, Fun. Tent, 4 and 135.
†Brugsch, op. cit., I.
His offices and titles are thus styled, in an inscription of that day:

"The hereditary Lord and First Governor in Memphis, the true author of the arranging of the temple-feast, the Architect in the town of the Sun, the Chief Superintendent of all the offices in Upper and Lower Egypt, the Head Architect of the King, the Chief Field-officer of the Lord of the Land, the Steward of the King's palace of Thothmeses III.—Amen-men-ant."

To the names then of Upjohn, Renwick, Hunt, Smith, Bartholdi and others most worthy of honor for the best architecture and decoration of New York, let us add the name of Amen-men-ant, the Architect of our Obelisk.

13. The City of the Sun. In Lower Egypt, at the upper end of the Delta, rose the little city of An, or Heliopolis as the Greeks called it, the City of the Sun, bristling with obelisks. "It stood upon a lofty plateau of rocks and sand, surrounded by deep canals and broad lakes, bordered by papyrus meadows and sycamore groves." The outer line of the present mounds has been traced out by the traveller, Pococke.

In approaching the front of the Temple of the Sun from the northwest, the pilgrim first passed between the most ancient pair of obelisks, erected by Osertasen I. of the Twelfth dynasty, about 2300 B.C. One of these was overturned by the Arabs, 1160 A.D., in search of hidden treasure, and the other still stands erect, the famed Obelisk of An, the oldest erect obelisk in Egypt. Then passing through the huge Pylon, the way lay through a long avenue of marble sphinxes
(some of which still remained at the visit of Pococke in 1743). Beyond rose four obelisks, immediately before the face of the temple. In the first pair, the one on the left, the north-eastern, was the one now in New York; the other, on the right, was the one now in London. In the second pair, was the one now standing in Constantinople, and the fate of the other is unknown.

To the Temple within, as the pilgrim was informed, the wonderful Bird of the Sun, with plumage of red and gold, the Ben-nu or Phoenix, came flying from Arabia, once in five hundred years; according to one tradition,* it bore a great ball of myrrh, with the body of its father enclosed, for burial; according to another, it flung itself into the altar-flame, was consumed, and rose again from its ashes—a consolatory type of the imperishability of all force and life and bloom. Around and about rose obelisks in wonderful number, some of them, according to report, a hundred and eighty feet in height, a Temple and City of Obelisks, as they called it, An-nu.

So many of these remained even down to the visit of Abd-el-Latif, in 1203 A.D., that he refers to them as "an innumerable multitude."† With the exception of a temple at Memphis, this was the most ancient of all Egypt—of antiquity so great that no chronicle existed even then of its first erection. The men who set up our Obelisk at An in the days of Thothmeses, nearly 3500 years ago, looked around, with the same reverence as we now gaze upon our own surviving monument, on the hoary walls of the Temple itself, and

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* Herodotus, Euterpe, II., 73.
† Pinkerton, op. cit., XV., 807.
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on the still more venerable shaft, the great obelisk of An and its fellow, set up on the rebuilding of the Temple, over 700 years before.

The slender, pointed shafts of the countless obelisks, blazing with gold, rose glittering into the bright clear air of the Egyptian Delta, before the thronging multitudes of worshippers, almost blending, before their admiring eyes, with the keen though kindly rays of the all-conquering Ra, the Sun-Force, the symbol of the warming, vivifying, re-creative power of Nature.

If this town was the actual birthplace of Thothmeses III. (as suggested by the statement on the west face of our Obelisk), very naturally he "embellished the house where he was born." So here, in the early part of his reign, probably between 1590 and 1580 B.C., amid the joyful din of the great Thirty Year Festival (as recorded on the south face), our Obelisk and its fellow were upraised before the taller pair, in front of the Temple of the Sun, thirty-five centuries ago.

It found itself surrounded by the far-famed seat and origin of the profound learning of Egypt, the holy fane to which pilgrims thronged from all the world to seek wisdom. The city was small, about three-quarters of a mile square, and every visitor must have passed almost under the shadow of our Obelisk.

Whatever in later days has inspired mankind, through the spirit and influence of a great world-university, such as that at Alexandria, Leyden, Salamanca, Heidelberg, and Oxford, was here concentrated in the Temple of Ra, with its 13,000 priests chanting before the huge mirror of burnished gold, the sacred hawk in the golden cage, the awful death-emblem, the pyramidal ben-ben, in its secret
chamber, and the sacred calf, Mnevis, on its purple bed. The anxious care, which this earliest of the nations gave to the education of woman, was shown in the convent school near by for the Ahi-t, young women of families of the priests; from its doors came the wedding procession of Asenath, the daughter of the High Priest, Poti-pher-Ra, on her way to the house of Joseph, the Hebrew Prime Minister of an early king.

At a later day, among the priests, there was one, afterward the Hebrew law-giver, Moses, who here received his education, and (according to Hecataeus, Strabo and Manetho) finally stood before the Sun-god as a priest. As he went in and out through the great portal of the Temple, he daily passed between a pair of obelisks, his robe probably at times brushing against the base of the eastern one, which now stands in our Park.

This city of An, too, we may venture to say, was one of the few places of early antiquity where at times might be gathered an assemblage of geographers; for the keen-witted Egyptian, though home-loving, was eager for knowledge concerning the wide world outside of the Land of Chem. Salt water, indeed, was to him an abomination and defilement, since it was the abode of evil spirits. So it was not until the time of the predecessor of Thothmeses III., his sister, the energetic and clever Queen Hatasu, of Amara, that Egypt had a fleet, the conscientious scruples of her warriors having been removed, before they embarked, by manning her vessels with Phenician sailors. Egypt also continued in constant connection with foreign geography through the overland caravans, as well as through the enterprise of the Phenician voyagers themselves, who were
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glad to bring to her spices from the Land of Pun-t, tin from Cornwall, corundum from the Island of Sapphire, and all other needed commodities from distant shores, at the very lowest market prices.

But the city of An was ever the particular goal of the foreign traveller. Among these students of the olden time, in humble attendance at the schools of the Temple of the Sun, were Pythagoras, Thales, the Grecian law-giver, Solon, the historian of Egypt, Manetho, and that great traveller, whom we call the Father of History, Herodotus. Here, later, came the geographer Strabo, to whom they pointed out the house in which, three centuries and a half before, Plato had spent three years under the instruction of the Egyptian priests, with Eudoxus, the astronomer, as his fellow-student. Memories of war, too, cluster around our monolith during its stay at An. It looked down upon the hosts of Shishak, marching northward past the walls to the destruction of Jerusalem, and three centuries later on the glorious array of Alexander the Great on his conquering march through the Land of Goshen.

We may well congratulate ourselves on the possession of a monument whose history has been so intimately linked, through these precious associations, with the City of the Sun, over which, at the time of his rebuilding of the sanctuary, Amenemha I. breathed the pathetic prayer (now recorded on the ancient leathern roll in the Museum at Berlin):*

May it not perish by the vicissitudes of time.
May that which is made endure.

But through the desolations of war and of treasure-

* Ebers, op. cit., I., 187.
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hunting, and the devastations produced by the building of Cairo, five miles to the southwest, there remains now, on the site of the famous city, near the little Arab-village of Mataria, the ancient obelisk of An as the only vestige, with a few rude mounds, ruined heaps of mud from the walls of a later Coptic town, the old spring of the Sun, and a venerable tree, the traditional resting-place, at a later time, of two Jewish fugitives and a little Child.

In the ancient time, however, at the period of the greatest glory of An, here stood our Obelisk for about 1055 years—a happy millennium, soon to be followed by disaster after disaster.

14. The Second King, Rameses II. In the Nineteenth dynasty, probably 200 years after (about 1385 B.C.), the illustrious Pharaoh, Rameses II., steps out on the field of Egyptian action. This is the second of the monarchs whose names are connected with our Obelisk.

This warrior-king led out his armies in every direction, and struck fierce blows at all the surrounding nations, who successively yielded to his sway. Among these, haughty Persia, overcome and ravaged by the armies of Egypt, trembled, but bided her time. Then Rameses, in the pride of his manhood, inscribed his name and glory, in double columns of hieroglyphs, on every one of the faces of our Obelisk, and reigned in peace. The long wars were ended, and the warriors rested and the priests sang, and the people rejoiced around our Obelisk within An. But from outside its walls came a minor tone, the sad refrain of the black-bearded captives from the land of Canaan in the brick fields. These are pictured at work on the walls of a
tomb of that period; their hard labor is done under the eye of the Egyptian task-master, who squats near by, with an inscription, "the stick is in my hand, be not idle!"

The great king Rameses died, after a long reign of sixty-seven years, and was buried in the Valley of the Kings. On the strange discovery of his coffin also, in 1881, among the others in the wild Libyan gorge, the royal mummy was taken to the museum at Cairo, unrolled, and the face of the monarch revealed, in his old age. Under the next reign, that of Menephtah I., the captives escaped from the brick fields and out of the city of An to Canaan, where they found a protector in Cyrus, the king of long humbled Persia.

15. The Third King, Osarkon I. Once more there is a record on our Obelisk, in the decline of the Egyptian monarchy, 400 years after Rameses II. Then came Osarkon I., 933 B.C., in the Twenty-second dynasty, a monarch probably of Assyrian origin. Of him it is said,* "There is every reason to believe that he was a peaceful and wholly undistinguished prince, content to add a few sculptures to the Bubastite portico of his father, and to rule Egypt in quietness during such term of life as Heaven might allow him. His portrait is that of a mild prince, not remarkable for energy or determination."

This gentle Pharaoh, greedy too after everlasting fame in Central Park, narrowly inspected our Obelisk and found two little spots vacant near the lower part of each face, and there he too inscribed his modest tale of virtue.

16. The Fourth King, Ra-mesuth. Four centuries after this, the opportunity presented itself to Persia, ever mindful of her past humiliation at the hands of Rameses, to wreak her long delayed vengeance.

In the sixth century B.C., the white sails of the Phœnician fleet suddenly glistened off the curved coast of Aigab-t, around the mouths of the Nile, as allies of Persia; swept the navy of Egypt from the Mediterranean, and came sailing up the sacred river. From the north a vast Persian host invaded Egypt, and defeated the forces of Psmetik III., after a fierce battle near Pelusium, in which 50,000 Egyptians and 20,000 Persians fell. Thus the savage Persian leader, Cambyses (or Kemba-thet) reigned as king of Egypt, assuming the throne-name of Ra-mesuth. Later in his reign, maddened by failure of an expedition and by suspicion of his subjects, he insulted and stabbed the embalmed body of an Egyptian predecessor, Amasis; scoffed at the god Pthah of Memphis, destroyed his images, and stabbed the sacred bull. Then marching his army through the Delta, he desolated the land with fire and sword, taking the city of An by storm, and the flames of the ancient Sun-Temple rose to the sky. The obelisks he hurled down, or mutilated, using fire and violence (as Strabo sorrowfully recounts), above all, we may be sure, on the first pair of Obelisks in front of the Temple, on which the hated cartouches of Thothmeses III. and of Rameses II. were incised. There was in the city (it is reported by Pliny), one magnificent obelisk, 11 cubits in breadth and 120 cubits in height (more than thrice that of our own), to whose foot the conflagration had reached, when the anger of the Persian
King gave way to admiration, and he bade his warriors extinguish the fire. So passed away the glory of An, about the year 520 B.C., and Alexandria gradually took her place as the world's centre of learning.

And there among the ruins, burned and blackened—possibly overthrown and prostrate, as some think—remained that first pair of obelisks, our own and its fellow, for over five centuries, with no new inscription but the fire-mark of the last King Ra-mesuth.

17. *The Fifth King, Augustus.* The recorded history of our Obelisk and of its mate now in London, thus traced for nearly sixteen hundred years, now approaches our era, when Egypt became a part of the Roman Empire. In the year 12 B.C., the eighteenth of the reign of Augustus Cæsar at Rome, these obelisks were both carried by the Romans from An to Alexandria on the sea-coast, and raised once more in front of the grand water-entrance of the Cæsareum (or Sebasteum), the great temple erected to commemorate the conquests of the Roman armies. For some reason, now unknown, the name "Cleopatra's Needle," even down to a recent day, has been attached to our own Obelisk while at Alexandria. It is certain that she had died eight years before the removal of the obelisks from An, but it is possible that the plan of their removal may have originated with her. It also appears that there were other monuments or public works in Alexandria with which her name was formerly connected. In regard to one of these, called, in 1743, the Calisch or Canal of Cleopatra, Norden remarked: "The name of Cleopatra, which it retains to this day, gives no ground for assumption as to the time of its original construction."
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Some work of repair, carried out at command of a queen of such celebrity, some amusement in which she may have taken part in that locality, or some festival which she may have there displayed, could easily have given occasion to this name."* The same explanation is applicable to the long current name of the Needle at Alexandria.

In the re-erection of the two obelisks, on their arrival from An, the Romans found the lower angles of both shafts badly broken away, and inserted four huge bronze crabs, about sixteen inches in diameter, under each shaft for support. This gave opportunity for another series of inscriptions on the crabs themselves. These record, in Greek and in Latin, the names of the emperor, prefect and architect, by whom the re-erection of the obelisks has been effected. Fragments of two of the ancient crabs are preserved in the Metropolitan Museum of Art, in this city, the original four having been replaced under our monolith by new castings of the same form, size and inscriptions.

At Alexandria, the two monuments remained through the exciting scenes of the revolt of the heathen in 366 A.D., in which the Cæsareum and neighboring temples were burned; through the capture by the Persians in 616 A.D.; through the siege and sack of the city by the Saracens in 640 and 646 A.D.; and through later captures in 823, 924 and 928 A.D. In 1203 A.D., both obelisks were seen standing by the Arab physician, Abd-el-Latif. In 1301, and again in 1303 A.D., violent earthquakes occurred, by one of which its companion was probably overthrown, while our own stout monolith

* Norden, op. cit., 19.
firmly held its place. After that date there are occasional records in the hasty visits of foreign travellers, and futile attempts were made to unravel the mysteries of its hieroglyphics.

One old traveller’s note in 1610 A.D. reads thus:

“Of Antiquities there are few remainders: onely an Hieroglyphicall Obelisk of Theban marble, as hard well-nigh as Porphyrr, but of a deeper red, and speckled alike, called Pharos Needle, standing where once stood the palace of Alexander: and another lying by, and like it, halfe buried in rubbidge.”

And another account in 1738:

“To-day there are only two solitary obelisks, of which one still stands in its ancient position, but the other is broken and almost buried in the ruins.”

To recapitulate its history thus far:

Our Obelisk was quarried about 3470 years ago at Syené, and borne to the City of An, and there stood for 1055 years.

About 520 B.C., burned and defaced by Cambyses, it remained over 500 years longer among the ruins of the city.

In 12 B.C., carried by the Romans to Alexandria, and there set up, it stood for 1890 years, down to 1879.

For at least 165 years previous to that date, the lower portion of the shaft and the entire pedestal and foundation had been buried in the sand up to the height of about twelve feet on the shaft, as reported by the traveller, Paul Lucas, who very likely chanced to tell the truth, when he visited Alexandria in 1714 A.D. It

* Sandys, op. cit.
† Norden, op. cit., I., Introduction.
is not generally known that when, on the defeat of Napoleon, in 1801, the Viceroy of Egypt presented

the fallen obelisk at Alexandria to England, he afterwards gave the standing one (now in New York) to France. The French were several times at the point of its removal to Paris, but found fault with its marred
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hieroglyphics. Led by their love for artistic perfection, they accepted the advice, in 1829, of Champollion the Younger, and, in 1836, took the beautiful eastern obelisk from Luxor in its place. Fortunately for us, for the loss by the marring of the Alexandrian monolith, however great, at the hand of time and violence, is far more than offset by the historic interest we possess, in the very scars of this veteran shaft of the ancient City of An.

18. The Rescue by the Republic. In its latter days at Alexandria, the monolith was fast approaching destruction through the climate, absence of protection from mutilation, and encroachments of the sea in the subsidence of the coast. Its threatening fate impressed a distinguished archaeologist, who wrote:

"The venerable monument, in its sordid surroundings, aroused no sentimental feelings; and it was only when it was seen from the sea that it had some picturesque charm or reminded us of the past greatness of the Greek city."

Gorringe has reminded us of the neglect with which the Obelisk was treated in the suburb of that city and "the feeling of disgust aroused by some of its surroundings. No one deemed it worthy of protection and care, even to the extent of preventing its defacement and the accumulation of offal around it. Two men made a business of breaking pieces from the angle of the shaft and edges of the intaglios, for sale to relic hunters. The disagreeable odors and clamors for backsheesh hastened the departure of strangers, who rarely devoted more than a few seconds to its examination. The con-

*Ebers, op. cit., I., 23.
stant washings of the surf had begun to affect the foundation, and, for the last fifteen years, the Obelisk had been gradually inclining more and more toward the sea. In a few years it must have fallen, and almost certainly been broken by the fall. But a more ignoble fate threatened it, in the proposition of some of the foreign residents of Alexandria to erect an apartment house on the adjacent ground, around the Obelisk, which was to adorn the courtyard."* This should suffice in reply to the question, sometimes asked, whether our Obelisk should not have been left to stand in its native land. In 1877, the first active effort to acquire the Obelisk for this country was made by Mr. William Henry Hurlbert, at that time editor of the New York World. It is fair to add that, ever since, the Obelisk has found, in the Press of New York, its most watchful and efficient defender in time of need. Through a single conversation with Mr. Hurlbert, a generous and public-spirited citizen, the late Mr. Wm. H. Vanderbilt, became interested in the matter, and undertook to defray all the expenses required to transport the Obelisk to New York, and to re-erect it at the chosen site in Central Park. These expenses much exceeded the original estimate, and ultimately amounted to the sum of $102,576. The transport of the Luxor Obelisk to Paris cost the French Government nearly $500,000. At the instance of Mr. Henry G. Stebbins, at that time a Park Commissioner, and of Secretary of State William M. Evarts, the assistance of our Consul General at Alexandria, Mr. E. E. Farman, was invoked. In 1879, the Egyptian Government, through the Khédive, Ismail, and

*Gorringe, op. cit., 1.
his successor, Tewfik, consented to the presentation of the Obelisk, as a free gift, to the City of New York. In order to carry out the conveyance to New York, the services of the late Lieut. Commander Henry H. Gorringe of the United States Navy were secured. Through his skill as a diplomat, an engineer and a navigator, as well as his courage as a man in face of the opposition of the foreign residents and subordinate officials at Alexandria, the Obelisk was successfully taken down, embarked and conveyed to this city. With reasonable pride, Gorringe reminds us that “the French waited about twenty-five years, and the English nearly seventy-five years before removing the obelisks they had selected. There was a feeling in Egypt that the Americans would certainly require a century to perfect their arrangements.” The total period from the acquisition and taking down of our Obelisk to its reerection in Central Park, inclusive, was less than fourteen months!

The series of steps in this transfer have been described in full detail, in the work of Gorringe. From the bottom of the shaft and pedestal the sand was dug away. A staging was first erected, and the entire shaft and pyramidal sheathed with heavy plank, after the removal of the staging. The column was then supported upon steel towers and enormous trunnions, gradually turned and lowered, finally launched in a caisson, towed to Alexandria, raised in a floating dock, and embarked in the steamer “Dessouf,” through a hole in its bow. After a voyage of thirty-seven days with a picked-up crew and rough officers, whom Gorringe describes as well fitted for a pirate, the
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pedestal was landed at West 56th Street, New York; but the shaft was disembarked at Staten Island upon pontoons, towed to the foot of West 96th Street, and there landed. Thence it was slowly dragged around the north end of Central Park, down Fifth Avenue, and on a trestle work at 82d Street, over to the knoll in the Park; once more raised and turned upon the heavy trunnions; lowered into its place, and at last successfully re-erected on its present site. It should be added that this alone, of all obelisks removed from Egypt, now stands on its original granite pedestal, and, beneath this, the original base of three tiers of lime stone slabs.

The Obelisk was thus finally raised, as we hope, for all time, on January 22, 1881. It had hardly settled into its place and the grounds around it been rearranged, when, only five months after, his life-work done, at the age of forty-four, Gorringe died. From photographs kindly made for me by Mr. Harry G. Caffall, of this city, I have already shown a view of the monolith obelisk which has been raised, as a memorial over the grave of Gorringe, in Rockland Cemetery, near Piermont, N. Y.; and I am glad to exhibit, what Commander Gorringe was too modest to include in the illustrations of his fine monograph on Egyptian Obelisks, his portrait, from the bronze medallion on the same monument. Born in Barbadoes, his life offers another example, like that of Alexander Hamilton, of the debt which New York owes to the energy of adopted sons of West India origin. As the inscription on his tomb records:

Brave, tender and true,
He passed away lamented by those who knew his worth,
Whose loving hands have raised this obelisk to his memory.
19. *The Hieroglyphic Proclamations.*—It will not be without bearing on our purpose, if we give attention to some of the hieroglyphs which cover the four faces of the Obelisk, and to which we owe our chief knowledge of its history and antiquity. These are well shown, though with some errors and imperfections, in the drawing made by Burton and Bonomi in 1827, while our monolith stood at Alexandria. Down the centre of each face of the shaft runs the self-laudatory inscription of the royal builder, Thothmeses III. In the column on each side you notice the modest remarks of Rameses II., two hundred years after. At the very base, the ascriptions of long life to the King—like the Hoch! the Hurrah! or the Vive l'Empereur! of later days. Near the bottom, on each side, the little bare spots which Osarkon I., four hundred years after, covered with his glory in diminutive characters.

Exception has been sometimes taken to the somewhat magniloquent and self-assertive tone of Thothmeses and his successors in these inscriptions, as well as the absence of greatly desired information from so ancient a record. But it will interest you to glance for a moment at the vignette, from the dedication of Capt. Norden's work on Egypt to King Frederic V. of Denmark, a little over a century ago.* In this the King stands enthroned as a god, with the obelisk bowed down before him, the pyramid withdrawn to the rear, the Sphinx aghast with admiration, the globe at his feet, and the President of the Royal Academy of Sciences of Copenhagen kneeling in humble submission.

20. *The Brilliant Gilded Cap.* We have next to con-

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*Norden, *op cit.,* 1.
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Consider the evidence of the former capping of the apex of the pyramidion of our Obelisk with gilded metal.
the south side of the New York Obelisk, there is good authority * to show that those in the central column inform us:

"Thothmes III. has made this to be his monument, in honor of his Father Tum [i.e., the Setting Sun], the Lord of An, and . . . has set up for him two large obelisks [note their sign in the middle of the face], the pyramidion being covered with gold metal," etc.; i.e., on this emblem of the sunbeam, the point or apex of the pyramidion was surmounted by a cap of gold or gilded bronze, which would glitter at the first touch of Ra, the morning light, and at eve send back the last gleam of Tum, the Setting Sun.

The careful archaeologist, Ebers, believes that the hieroglyphs on our Obelisk were themselves gilded. He states, "The hieroglyphs engraved in the granite, to perpetuate the glory of his name, were inlaid with silver gilt, and its point was capped with the same metal. It was dedicated to the Sun-God, Ra, and formerly the beams of the day-star were mirrored in the polished surface of the granite and gold." To this, he adds the footnote: "The expression on the Obelisk itself, tasm or yasm, appears to mean gilded; for the word does not appear in any lists of metals, nor does it enter into the computations of metals, or lists recording the weight of different kinds of gold." † Moldenke translates the same word, usem, as gold metal, with the note: "The gold metal mentioned here may have been only an alloy of copper and gold. Some think that it was the electrum of the ancients, which was an alloy of silver and gold."

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* Moldenke, op. cit., 76.
† Ebers, op. cit., I., 23.
Elsewhere he states: "The stone was polished to a high state of perfection, and the inscriptions added in intaglio-relievo by skilled stone-cutters, under the direction of scribes. Whether the figures of these inscriptions were filled out with copper or gold, as some maintain, is extremely doubtful. With the pyramidion, it was different. While its usual dedicatory inscriptions remained undoubtedly as they were chiselled, the point or apex seems to have been surmounted by gold or gilded bronze. . . . It would appear, from extant obelisks, that, in order to have the gold added, the stone apex was not brought out to a fine point, but left rugged and incomplete." *

Exactly the same testimony is borne by the inscriptions on the obelisks at London, Paris, and Rome. The archaeologists of London and Paris have repeatedly expressed strong protest † against the omitted replacement of the ancient gilding upon the two monoliths in those cities, which now, gray, dull and forlorn, present but a dismal caricature of their ancient glory.

On this deplorable effect, a French traveller in Egypt remarks:

"The Luxor Obelisk, after so many centuries of antiquity, is now as young, as brilliant as the day when the hand of Sesostris placed it upon its pedestal. Its stone has the same tints of a pale rose color; and under the floods of light which this fiery sky pours down upon it, one would suppose it to have but yesterday arrived from the bosom of the quarry of Syené. I confess that I could not avoid some comparison, since that time, when

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* Moldenke, op. cit., 18 and 59.
† Perrot et Chipiez, op. cit., I., 621, etc.; Cooper, op cit., 85, etc.
once more I looked upon its twin brother, transferred
to the midst of the fogs of the Seine, dyed by the rain
to a grayish tint which made it resemble the Fontaine-
bleau sandstone, bleached, discolored and already
disintegrating, under the influence of a foggy and in-
hospitable sky."* 

The inscriptions on the pedestal of the Paris Obe-
lish, in the Place de la Concorde, are gilded, and M. J.
J. Hittorf, the designer of the pedestal, offered a strong
argument in favor of putting a bronze cap, possibly
gilded, upon the pyramidion of that monument.

Other authorities state, of the same obelisk, "the
apex is left unfinished, and still seems to demand, in
the damp air of Europe, the protection of its former
gilded cap," † and "it appears belittled by its erection
as a solitary monolith, in the Place de la Concorde, and
without its former gilding." ‡

On the London Obelisk, the former companion of
our own at An, in the central column, on the first (east)
side §, Thothmeses announces:

"He made [this] in his monuments to his father Hor-em-mak-hhou. He
erected two very great obelisks, capped with gold (when he celebrated) the
panegyry of his Father, who loves him. He did (it), the son of the Sun, Thoth-
meses, the best of existences, Beloved of Hor-em-mak-hhou." ||

The sign of the pair of obelisks, above referred to,
is distinctly preserved both on the second and fourth
faces of this obelisk, and is well shown by Champollion-
le-Jeune in Plates ccccxlv. and ccccxlvi. (op. cit.). This
testimony from the London monument is equally con-

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* Poitou, op. cit., 275.
† Cooper op. cit., 85.
‡ Perrot et Chipiez: op. cit., 621.
§ Cooper, op. cit., 134.
|| Parker, op. cit., T. L. Donaldson, 29, and S. Birch, 43.
clusive in regard to its New York consort, particularly in view of the results of Dr. Moldenke's study of the characters on its south face.

For other evidence in the same direction we may return to the very tip of the pyramidion of our own monolith. It is not generally known, and no reference is made to the fact in Gorringe's book, that this apex was imperfect when the Needle stood at Alexandria. This is distinctly shown in all photographs up to 1879, in many of the drawings by travellers for a hundred and fifty years before, and in Plate ccxxlv. of Champollion-le-Jeune. Gorringe had this apparent defect repaired in 1880 by surmounting it with a new piece of granite about six inches in height. This is now the more plainly visible from below, as the cement with which it was attached has been unfortunately in part dissolved out by rains, and has run down and whitened the faces of the pyramidion below. It is, I think, more than a curious coincidence, that the pyramidion of the London obelisk is also truncated in the same way, as shown in the two plates of Champollion-le-Jeune, already mentioned. In regard to this it is stated: "The apex is roughly cut and damaged, it having been covered, like most of the obelisks of Thothmeses III., with a bronze cap." *

The same truncation and imperfection have been already noted by Champollion-le-Jeune on obelisks in the second court of the Palace at Karnak (Plate scxxii., ccxxiii., and ccxxiv.), and by all observers, in regard to the ancient obelisk at An, the Luxor obelisk and its fellow at Paris. In the case of these last two, a

* Cooper, op. cit., 125.
shoulder around the base of the pyramidion renders certain, what may be equally true of the New York obelisk and the rest, that the shaft was originally left imperfect at the top, with the expectation that it would be perpetually covered by a metal cap. But it is also possible, in our own monolith and that of London, that, during its mutilation by the Persians at An, the glittering gilded tip may have been struck off, both metal and the stone beneath, as a piece of plunder.

Again, before the new tip was put on the pyramidion of our monolith, Gorringe found traces of ancient cement adhering to the faces below. He gathered a gram of this, to be chemically examined for traces of gold or copper, as he states,* “to determine whether or not the pyramidion had been gilded or covered with bronze.” As only a mere trace of copper (0.04 per cent.) was found in these few particles of cement, he came to the conclusion that “there was no evidence of either gold or copper having been attached to it at a previous period.” However, the very presence of that cement would seem to testify to the former attachment of some object to the pyramidion—plainly the gilded cap referred to in the inscription below.

There is another fact, observed in the figures carved upon the pyramidion, which may have similar bearing on our present subject. In the squares on two of the four faces, the Sun-god Ra is represented, and on the other two, the Sun-god Tum. It is strange that the head of Ra in both cases is now nearly effaced, while that of Atum is well preserved. Gorringe states: “It is barely possible that the head of Ra may have been

* Gorringe, op. cit., Appendix, 159.
gilded, while that of Atum was only polished like the rest of the surfaces, and that this gilding may have been the cause of the obliteration."* However, if either was to be distinguished by gilding it would certainly have been Atum, to whom the Temple of the Sun was dedicated, at least during the XVIIth dynasty; the effect of gilding could only have been toward protection against the sun and weather; and the effacement of the head of Ra may have been due to the hand of violence of some zealot of Atum, or of some marauder in the service of Cambyses.

Again, the exquisite and wonderful sharpness and perfection of a large part of the hieroglyphs on the four faces of the pyramidion, surfaces peculiarly exposed to weather erosion, may indicate former protection by direct gilding upon that part of the stone.

Another reason for the replacement of the gilded cap upon our Obelisk is the fact of the general, if not universal, Egyptian custom of decoration of their obelisks in their original condition, both by high polish of the stone, and by attachment of gold in the form of gilding to the entire surface of the pyramidion, or of a gilded cap of copper or bronze, or by filling the incised hieroglyphs over the entire monument with pure gold or gilded bronze, or by gilding the whole shaft (except the intaglions) from top to bottom. In the Hay Collection of Antiquities at Boston, Mass., there is now "a large fragment of well polished, red syenitic granite, having upon its surface the remains of gilding."† Some of the evidence on this point will be here presented.

*Gorringe, op. cit., 62 and 63, note.
†Cooper, op. cit., 28, footnote.
As to the oldest erect obelisk, that of Osirtasen I. of the XIITH dynasty, now standing on the site of An, and its long buried companion, the Arab writer Kodhai refers to them both as “being extremely wonderful. On their summit are two pointed caps in copper,” probably gilded bronze.* This obelisk is square, formed of a single block, pointed at the top, which is a covering of copper as yellow as gold, above which is the figure of a man sitting in his chair, looking at the rising sun. The companion was overturned by the Arabs in 1160 A.D., in search of treasure supposed to be buried beneath, of which exploit Mohammed, the son of Abdarrahim, discreetly remarks, “that one of the obelisks of Pharaoh, which were at Mataria, near Cairo, fell down, and a great quantity of copper was taken from the top.”† The copper cap on the erect obelisk at An was still seen, in 1203 A.D., by the Arabic physician Abd-el-Latif, and by various other observers since.‡ The two obelisks of the temple of Luxor, in Thebes, were erected by Rameses II., and excel all others in artistic execution; one still remains at Luxor, and the other was removed in 1836 to Paris. Mariette maintains that the summit of each was covered with a cap of gilded bronze,§ and this is confirmed by the rough execution of the pyramidion, and by a bevel below, intended to receive the edge of the cap. He also believes that the rough faces of the entire shaft were completely gilded, with the exception of the highly polished bot-

* Moldenke, op. cit., 123.
† Parker, op. cit., 29.
‡ Pinkerton, op. cit., xv., 802 and 827.
§ Also Wilkinson, Gen. View of Egypt, 316.
toms of the hieroglyphs, which remained uncovered, retaining the natural color of the granite.

At Karnak are two obelisks of Queen Hatsu of the XVIIIth dynasty, the sister of Thothmeses III.; one is fallen and the other erect, the latter 97$\frac{1}{4}$ feet in height, the loftiest now standing in Egypt. Around the base runs an inscription:

"The Queen, the pure gold of Monarchs,
Had dedicated to her father, Amen of Thebes,
Two obelisks of mahet stone (red granite),
Taken from the quarries of the south.
Their upper parts were ornamented with pure gold,
Taken from the chiefs of all nations,
Her Majesty gave two gilded obelisks to her father Amen,
That her name should remain permanent,
Always and forever in this Temple.
Each was made of a single stone of red mahet stone,
Without joint or rivet.
Her Majesty began the work
In the fifteenth year of her reign,
The first day of the month Mēchir, of the sixteenth year,
And finished it on the last day of the month Mesore,
Making seven months from its commencement in the quarry."*

In reference to this inscription, Mariette-Bey states:

"1. The summit of the obelisk was covered over with 'pure gold taken from the chiefs of the nation.' Unless this simply implies an apex overlaid with a casing of gilded copper, as the apex of the obelisk at Heliopolis must have been, this inscription possibly refers to the sphere (of gold?) which is represented on certain bas-reliefs at Sakkārah.

"2. The obelisk itself was no doubt gilded from top to bottom; in examining closely, one may notice that the hieroglyphs were carefully polished, and moreover that the plain surface of this monument was left compara-

*Cooper, op. cit., 32.
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...tively rugged; from which it may be inferred that the plain surface, having a coating of white stucco, the like of which may be seen on so many Egyptian monuments, alone received this costly embellishment of gilding, the hieroglyphs themselves retaining the original color and actual surface of the granite." *

There are also at Karnak two obelisks of Thothmeses I., one fallen and broken, the other erect, 71 feet and 7 inches in height. Concerning the pyramidion of the latter, Cooper states: "The pyramidion at the apex, which is rather more acute than in the later examples, is also adorned with a votive vignette, and is the oldest illustration of that practice. Evidently, therefore, this obelisk was never designed for a metal covering, but it may have had its summit gilded for the better preservation of the sculpture upon it... for its highly polished surface would not prevent such an application of the precious metal."

On the walls of the Temple at Karnak, according to Wilkinson,† there is a representation of the dedication of an obelisk (probably the Lateran obelisk), in which this is described as "resplendent with gold." On this obelisk of St. John Lateran, now at Rome, by some authorities‡ considered one of the former companions of the New York obelisk at An, the hieroglyphs of the right column, on the south side, inform us:

"The son of the Sun, Thothmes (IV.),
Diadem of diadems, set it up in Thebes;
Capping it with gold,
Illuminating Uas with its beauty." §

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* Mariette Bey, op. cit., 171.
† Manners and Customs, III., 237.
‡ Parker op. cit., 2.
§ Birch, in Parker, op. cit., 45; Cooper, op. cit., 40.
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"In a fragment from the Temple of El Assasif, amidst a list of offerings which this monarch presented to the Temple of the god . . . are described
*two obelisks (of granite) rising to a height of 108 cubits, inlaid with gold throughout their length, made in their rays."*

These obelisks have long disappeared."

Dr. Birch also mentions that the tombs in the Libyan range, behind Gournah and El Assasif, "are full of the scenes of the reign of Thothmeses (III.). Two great obelisks of 188 cubits high, with gilded tops, are recorded in these sepulchres."

Two obelisks were also given by Thothmeses III. to the Temple of Amen. "On each is one vertical line, containing the names and title of the King, and that
*he has set up two great obelisks capped (ben ben am nub) with gold."†

At Tanis, Petrie observed a sunk surface all over the pyramidion of one obelisk: "This was doubtless to fit on a cap of metal, flush with the general surface. It is singular that this evidence of a cap should remain, while the fellow obelisk is quite smooth to much nearer the apex."‡

A singular application of another metal to the same purpose, only possible in so arid a climate, is recorded on the last of the Pharaonic obelisks, two small ones of Nectanebes, from the vicinity of Memphis, and now preserved in the British Museum. On one side, the King states, "he has set up an obelisk in his house of basalt; it is capped with black metal (iron); they have given him all perfect life, like the sun."§

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* Lepsius, Abh. III., tab. 27, 11.
† Dr. Birch, Parker, op. cit., 42.
‡ Petrie, Tanis, 26.
§ Parker, op. cit., 55.
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Again, it should be remembered that the very object and idea of the obelisk, as an emblem of the dazzling Sun-beam, required, for the desired impression, both lustrous polish and brilliant gilding. The imposing and inspiring effect originally produced by this decoration may be understood from the following quotations:

In an inscription on a wall in the Temple of Amen at Ape, there is a description of the obelisks raised by Thothmeses III., in the construction of which silver, gold, iron and copper were not spared, and “which now shine in their splendor on the surface of the water, and fill the land with their light like the stars on the body of the heavenly goddess Nut.”

In a similar way the impression produced by the obelisks of Queen Hatasu (or Hashepes) is described:

“The woman-King Makara, the gold among Kings, she has executed (these obelisks) as her memorial for her father, Amen of Thebes, since she had erected to him two large obelisks of hard granite of the South; their tops are covered with copper of the best war-tributes of all countries; they are seen a great many miles off; it is a flood of shining splendor when the sun rises between the two.”

Their effect at a distance must have been (as suggested to me by Prof. G. W. Plympton) like that of our modern heliographs.

In the Flaminian obelisk, formerly erected at An by Seti I., and now on the Piazza del Popolo, at Rome, Seti is mentioned in the inscriptions of the central column on the west side, as

“The King, Pharaoh, establisher of justice, (Who) fills An-nu with obelisks,
To illustrate with (their) rays†
(Or, “in the light of the beams of”)*
The Temple of the Sun:”

* Brugsch, op. cit., I., 378.
† Parker, op. cit., 16.
‡ Birch, Parker, op. cit., 47.
here also we find a plain allusion to these monoliths as emblems of the Sun-beam.

In view, therefore, of these four points, viz.,
(1) the testimony of the hieroglyphs on the south face of our obelisk, and of those on its fellow, now at London;
(2) the indications of cement still adhering to the pyramidion and its broken off apex;
(3) the predominant custom of gilding their obelisks by the ancient Egyptians and by the sovereigns of this dynasty, particularly at An; and
(4) the appropriate effect of brilliance, intended to be produced by an emblem of light,

I would submit to the judgment of this Society, the educated citizens of New York, and the intelligent Park Commissioners who have this monolith in their care, that good taste and consistency require the following restorations:

(1) the addition of a well gilded pyramidal cap of some durable metal, for a short distance down over the apex of the pyramidion, perhaps nearly down to the picture squares. For the protection of the monolith from lightning, this cap might be connected with the ground by a stout copper lightning-rod, running down the N. W. (the least conspicuous) corner; it should be, at least in the upper part, gilded, to prevent staining the stone.

(2) the gilding of the surface of the stone, over the rest of the pyramidion-surface.

(3) the gilding of the hieroglyphs below, perhaps only those of the original central column of Thothmeses III., down to the bottom of the shaft. This
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would chiefly apply to the N. and E. sides, as the hieroglyphs are largely obliterated on the S. and W. sides.

Such a replacement of the ancient decoration need not be expensive, and would prove a very efficient additional protection of the monolith from weather attack and entrance of moisture at its summit, the most vulnerable point, as well as within the hollows of the intaglias.

21. The Attack of the Last Enemy. It need hardly be added, how irreparable would be the loss to the value and interest of the obelisk in our eyes, if there should be any further injury to these hieroglyphics. Through them we trace almost its whole story of adventure. Yet this is the very danger which still threatens many of them, but a danger which can be prevented. For we have now to consider the decay of its surface until eight or nine years ago. As to the causes of that decay many views have been advanced, whose discussion is deferred to another occasion. When warned, it is said, even before the erection of the monolith, in regard to its need of protection against our climate, Commander Gorringe seemed to find it as difficult to believe that the imperishable "heart-stone" of Syené could be in danger, as to anticipate that, in a few months more, his own stout heart would give way forever on earth; and he replied: "The Obelisk has lasted nearly 4000 years, and will probably last 4000 more."* This seemed to be confirmed by the examination of a geologist from Philadelphia, who reported that the stone was sound. But, in defiance of the Quaker, within a couple of years, little pieces of the granite began to

The Misfortunes of an Obelisk.

drop all around the base. Almost an ounce of these was then swept up by another expert and carefully weighed, who reported that, at that rate, it would take 6000 years to do any appreciable harm.*

But now great flakes began to fall. For there was a deep and insidious internal decay going on, of which

he had no suspicion. This I can now illustrate to you by two views: first, by a photograph, under the microscope, of a thin slice of the original granite fresh from the quarry of Syené. This shows the feldspars and other minerals in a comparatively solid and transparent condition, tightly hugging that bright little crystal of oligoclase—the most perishable of all—in the middle.

But now look on this picture—a similar slice from a decayed flake on the surface of the Obelisk, after near-
ly five years' weathering—as it must be confessed, full of the crow's feet and wrinkles and lines of age. Such are the results of life in New York!

In the fall of 1884, the danger was brought to the notice of the Park Commissioners, who decided, but not until the fall of 1885, to resort to a water-proofing process, founded on the application of melted paraffin to the artificially warmed surface of the stone. As I was not then consulted on the matter, I feel the more free to express the opinion that the selection of this process was most fortunate, in regard to its own fitness for the purpose in view; while, of course, if it had not been under patent, its application to a public monument would have been preferable and less open to objection. Meanwhile the poor Obelisk had stood here, entirely unprotected from the elements, for four years and eight months.

In the preliminary cleaning of its surface, many spots were found deeply decayed, especially on the south and west sides of both shaft and pedestal—some large pieces so loose that they would scarcely bear the hand upon them without falling. A Park Commissioner directed the manager “not to remove any flakes from the surface unless he was obliged to do so.” A large number of those flakes hanging most loosely and crumbling were so removed, to the extent of two and one-half barrels full. This whole procedure, which, of course, had no necessary connection with the subsequent process of treatment, was due to a most deplorable error of judgment. All the loose fragments should have been hardened and re-cemented in place, whatever the time and cost required. The sculptured surface of the Obelisk,
in its misfortune, should have been skilfully treated for preservation, as a jeweller would treat the crumbling surface of an ancient intaglio.

On Nov. 6, 1885, the water-proofing was begun and completed in a week. Flat surfaces of the stone were warmed for a couple of minutes by a charcoal stove, held an inch or two away, and projecting parts by a benzine blast-lamp. Then the melted paraffin was applied with a brush, and, the surface being re-warmed, the paraffin sank into the stone, probably a little over half an inch. Since that date, during the last seven years, there has been no sign of further change in the stone, no visible decay, not a single fragment fallen.

In regard to the preservation of similar obelisks in Europe, it may be added that the Paris obelisk, formerly at Luxor, was varnished with a solution of caoutchouc; the London obelisk, soon after its arrival, by the engineer, John Dixon, with a solution of water-glass, and again, later, by Mr. John Browning, with a solution of gum dammar, containing also wax and corrosive sublimate. There is some uncertainty whether, on either monolith, the surface has been satisfactorily protected from crumbling.

In the winter of 1889, a committee of six persons, appointed by the Park Board, as experts, re-examined the Obelisk, made various experiments, and unanimously reported, in the following May, 1890, that they had found the general surface satisfactory, and the water-proofing process so well adapted to the purpose that it was desirable to introduce more paraffin to a greater depth into certain of the old badly decayed spots. A chart of these was prepared, numbered down-
ward on each face. When lightly tapped, such a spot gave forth a dull, hollow sound, indicating that a fine 

*DECAYED SPOTS, FACE OF NEW YORK OBELISK.*

...
the Ice King, the tiny sheet of water will expand with irresistible force, and a hieroglyph will fall.

In the early part of July, 1850, a second committee devised certain changes in the apparatus and process, to promote the utmost safety in its application. Experiments were carried on upon a huge boulder of granite of similar nature, discovered near Bronxville, in Westchester County, fully three times the bulk of the obelisk. But let no one trust the apparent evidence of his own eyes and hereafter charge that this huge boulder was roasted until it split in two! Nature cleaved that rock long ago. The low degree of warmth really used can be judged from the fact that a child might plunge his hand, like a martyr of old, into the caldron of melted paraffin, but without discomfort; it is a temperature of 146° F., that in which the surfaces of this and other happy obelisks have basked in the sun of Egypt for thirty or forty centuries.

It was recommended by the Committee, to use only the charcoal stove, and to apply that at a distance of two feet from the decayed surface, for a period of at least two hours on each spot; then immediately to adjust closely to the spot a three-sided tank, kept filled with melted paraffin, as long as this would soak into the warmed stone—to a depth of about 2 inches. The process would require over four hours' careful work on each of the decayed spots, of which there are about 111.

As to cost, you may remember the statement by the Director of the Metropolitan Museum of Art, that the care of a single collection in that building now costs $4000 per year. The expenditure of about half that
sum, once for all, is likely to complete the protection of these spots. So far too, remember, the Obelisk has itself cost New York City nothing; with the help of its good friend, it came to us a free gift. The only expense, less than a thousand dollars, resulted from our own neglect of it, up to the year 1885.

In response to these recommendations of the committees, nothing was done in the summer of 1890. But a perusal of the attractive columns of the City Record, December 30, 1890, exhilarated our hearts over an official notice, to the effect that, at last, on application of the Park Board, the expenditure of $2800 on the re-treatment of the decayed spots, had been authorized by unanimous vote of the Mayor and Board of Aldermen.

Since then the two Committee reports have reposed, perfectly safe and innocuous, in the archives of the Park Board.

Last June, 1892, however, an application was made by the President of the Park Board, for an appropriation of $2000 for the purpose, to the Board of Estimate and Apportionment, and, I am informed, this appropriation for the repair of the Obelisk has since been made. Under the supervision of the President of the Board and his able associates, we may now confidently look forward to speedy preparations for this important work, since they have now entire authority for the expenditure, and also—most lucky of Boards—the means! But beyond the coming summer, there is peril. Where an Obelisk is concerned, it is as dangerous to play with frost as with fire. We know the fancied security and its disastrous results from the years 1881 to 1885.
Meanwhile, there stands the monolith, in this last misfortune, to face the bitter winter, its decayed spots still giving to the touch that ominous hollow sound. If we have reason to prize it as a unique relic of antiquity, the oldest on our continent; or for its testimony to the workingman of New York of the patient and thorough work of his brother at Syené; or for its precious historical and religious associations; or, above all, as it seems to me, for its cheery message from the wisest and most patient of ancient nations to the most active, restless and discontented nation of to-day, a message of light and hope—the good time coming—then let us guard and care for our trust.

All Central Park in its beauty might be blotted out and be revived again; but all the wealth of New York could not replace one fallen hieroglyph.
IV.—A Study of the New York Obelisk as a Decayed Boulder.

BY ALEXIS A. JULIEN.

Read April 24, 1893.

LITERATURE.


*ANNALES N. Y. ACADEM. SCI., VIII, June, 1893.*
Study of the New York Obelisk as a Decayed Boulder.


Poole, R. S. Encyclopaedia Brittanica. Article "Egypt." VII.


To the geologist, musing over a rusty coated, ice-scratched pebble—picked up, perhaps, the other day in Central Park, not far from the base of the Obelisk, or over some huge boulder, which, on tap
of hammer or thrust of cane, tumbles at once into fragments, a fascinating but most perplexing problem is offered in trying to unravel the vicissitudes of its past history. Through the work of Dolomieu, T. Sterry Hunt, and others, we have caught some glimpses of its quiet youth, when, locked up within the original rock-stratum, its rounded form was first slowly etched out by the underground gnomes—the forces of subterranean disintegration and chemical decay.

Then followed the stirring experiences of its middle age, when, in our latitude, torn out by torrent or by the continental glacier from its softened bed, it was rasped by partly decayed and angular gravel, hurled down deep fissures, crushed under the enormous weight of thousands of feet of ice, jammed against other boulders, ground down over the rocky glacier-bottom, and at times rolled over and over in the rush of a glacier-river.

At last came old age, when, stranded upon the surface of the land, it was drenched by rains or melting snow, repeatedly surface-dried by intense heat of summer's sun, even roasted at times by passing forest-fires, frozen and thawed again and again, and soaked in organic acids from soil or swamp, until completely changed in molecular arrangement, and partly in material, through and through.

Within, by absorption of oxygen and water, and consequent production of new salts and combinations of increased molecular volume, the entire aggregate of mineral crystals remained locked in intense strain, the relief attained by partial closing of old joint-planes having been offset by development, through such minerals as the feldspars, of innumerable fine clefts and spongy vacuoles.

Without, by the insinuation of water and thrusting force of frost-crystals, the co-adherence of the grains was loosened, the inner strain largely relieved, and the outer part of the boulder expanded in a series of coats, successively softer, more porous and swollen toward the exterior.

So at last the successive crusts have tended to exfoliate and fall away, until many an aged boulder has crumbled to fragments and dust, with its story forever untold.

In the case of some particular boulder, the student may often make out part of this history, its original site and source, its glacial experience, the distance of its transport, etc.; but as to the exact agents of decay, their relative efficiency, and, especially, the duration of the trial, he possesses no measure and can make no estimate.
96 Study of the New York Obelisk as a Decayed Boulder.

If only some boulder could be found whose whole story was known, whose hieroglyphic striae could be entirely interpreted!

It has occurred to me that on many of these points we may be able to gain some facts of value through a special study of at least one huge block of hewn granite, whose known but vast antiquity renders it, to some degree, comparable with a natural boulder, while its record of varying experiences of natural and artificial agencies of destruction is quite definitely known. A recent re-awakening of public interest in the Egyptian Obelisk, now in Central Park, New York, and of anxiety as to its permanent preservation, led to the appointment, in 1890, by the Board of Commissioners of the Public Parks, of two successive Committees of Experts to consider these subjects. Service on these committees gave me the opportunity of commencing a series of experiments, whose continuance, at intervals, during the last three years, has yielded the results presented in this paper.

Moreover, the Nile valley, as well as the streets and squares of European capitals, is strewn with similar Egyptian boulders, of huge size and of the same homogeneous granite, which have long lain in definite positions, exposed to known agencies of geological change, during periods coeval with the establishment of ancient dynasties, often yet plainly recorded upon their faces. For at least the partial elucidation of our problem, we are fortunate to possess, in this peculiar class of historical monuments, a happily arranged series of trial-boulders of approximately known age and tests.

The history of the Obelisk is naturally divided into four periods, corresponding to the four sites it has occupied: Syene (Sun-t or Assouan), where it was quarried; An (On or Heliopolis), where it stood erect for about 1050 years, and then perhaps lay prostrate for 513 years longer; Alexandria, where it stood for 1893 years; and New York, where it has fought with the elements for over 12 years, since its re-erection, January 22, 1881.

I. SYENE.

At this point, 560 miles north of Cairo, the great range of the Libyan Mountains, called the Gebel Silsilib, "Mountain of the Chain," is crossed by the Nile through a narrow gorge. Above, its obstruction of the waters of the river, with a chain, as it were, of rocky ledges, forms the famous First Cataract. In these moun-
Study of the New York Obelisk as a Decayed Boulder. 97

tains, on the east side of the river, a short distance above the present village of Assouan, lie the old quarries of Sun-t ("Entrance giver") of ancient Egypt, which yielded the so-called "oriental granite," "syenitic marble," or "Thebaic Stone," out of which nearly all obelisks and colossi were cut. This was the "machet" or "mahet," "heart-stone," of the old Egyptians, so-called, it may be, on account of its hardness and durability,\(^1\) perhaps in connection with its bright red color. For the same reason, on account of its flame-colored crystals of microcline, the Greeks afterward called it pyrosmoecion, the fire-variegated stone.

1. Mineral constitution of Syene granite.

According to the observations of Russegger, as Prof. Alfred Stelzner states:

"The structure and composition of the 'Oriental granites' are very variable. Coarsely granular varieties, made porphyritic by microcline\(^2\) crystals, which are distributed without regularity in the main mass, seem to be the most usual. They occur immediately in the neighborhood of Syene (Assuan). Out of these are developed locally (for instance, on the road along the cataracts of Syene) such coarsely granular masses, that the individual feldspar and quartz constituents reach the size of a cubic foot; in other places, the size of the grains diminishes, and then there results, by a parallel arrangement of the flakes of mica, a gneissoid rock. Among the varieties of composition three are especially given. That which seems to be most widely distributed is an amphibole-granite, containing biotite, in the composition of which microline,\(^2\) oligoclase, quartz, amphibole, and biotite take part. Some of the principal localities for this are the old quarries near Syene, and, besides this, Djebel Gareb and Djebel Ezzeit. This principal rock, by the gradual diminution of its hornblende, either merges into normal biotite-granite, which may be either rich in mica (east side of the hill on which the town of Syene is built) or poor in mica (Debu); or it passes, by disappearance of its quartz and the predominance of its hornblende, into normal syenite."

By the last term, Stelzner refers to the combination of microcline (or of orthoclase) with hornblende, free from quartz, to which the German petrographers now confine the name syenite. The porphyritic hornblende granite of the old quarries of Syene varies also

\(^1\) Lenormant, op. cit., 25.  \(^2\) Frazer, loc. cit., 367.
greatly in lithological constitution. Commonly it consists of bright red to yellowish red microcline in large twins; white oligoclase, sometimes yellowish or greenish; smoky and gray quartz; black biotite, sometimes brown or green; the last often replaced in part or altogether by black amphibole. Less commonly occur yellow mica, pyrite, magnetite, and dark brown garnet. Hematite in hexagonal or rhombic reddish plates, yellowish red titanite, colorless apatite, zircon, viridite, and yellowish green needles of pistazite have also been detected. Newbold also reports: "Schorl, black and green, and actinolite are minerals occasionally found in the granite of Upper Egypt, as well as the chrysoberyl."

In the quartz, Stelzner also distinguishes capillary black needles, which I have recognized as rutile; and in its larger grains, cloud-like zones of fluid cavities, in the smaller of which the bubbles show invariably more or less motion. To this I can add, from examination of my own thin sections of rock from the Obelisk, that the fluid contents of these cavities consist sometimes of brine, sometimes of liquid carbon dioxide. Delesse attributes its smoky tint to the presence of a very small quantity of organic matter.

As to the proportion of the main constituents, the following percentage results have been reported:—

<table>
<thead>
<tr>
<th>Component</th>
<th>By volume</th>
<th>By weight</th>
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<tbody>
<tr>
<td>Mica</td>
<td>4</td>
<td>36</td>
</tr>
<tr>
<td>Quartz</td>
<td>44</td>
<td>33</td>
</tr>
<tr>
<td>Microcline</td>
<td>43</td>
<td>31</td>
</tr>
<tr>
<td>Oligoclase</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
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In my examination of the four sides of the Obelisk in 1890, while hanging in a chair from its summit during several days, I recognized, in addition to the common constituents already named, the occasional presence of magnetite, and, on the upper part of the N.N.E. face, very rare particles of pyrite, giving rise to slight ochreous rings of decomposition.

2. Distribution and condition of minerals on the surface of the Obelisk.

In examining the W.N.W. face of the shaft, black mica was found to be specially abundant, in bright scales in large part inclined about

1 Newbold, loc. cit., 340.
2 Delesse, loc. cit., 489.

* G. W. Wignor, loc. cit.
45° toward the north. Occasional large bunches of granular hornblende occur, elongated, with their major axes inclined to the N.N.E., marking the original bedding plane of the granite. The microcline crystals are often 1 inch long by \( \frac{1}{2} \) to \( \frac{3}{4} \) of an inch wide, with high lustre on many fresh faces. Those of the white feldspar (oligoclase) were occasionally bright, but, in larger part, dull and whitened. However, I was rarely able to detect fine cracks in any of the feldspar, even on the old weathered surface. Near the bottom of the shaft occurs a thin seam of hornblende-gneiss, several yards in length, dipping sharply toward the north like the vein at the bottom of the E.S.E. face.

On the N.N.E. face of the shaft, the feldspar generally looked dull, except on small half inch cleavage-planes, here and there. Many masses of hornblende occur, all of dull black color, but without products of decay. A small bunch of pyritous material, nearly 2 cm. in length, was seen, blackened and dull. A large crystal of white oligoclase, 2 cm. long, was covered with a dull white crust, 1 mm. in thickness. In and around the two cartouches of the second row from the top, a large amount of hornblende occurs. At the two cartouches of the third row, below the middle of the shaft, the decay and dropping out of mica scales have caused much pitting of the surface.

On the E.S.E. face of the shaft, between the legs of the middle bull, a streak of hornblende-gneiss occurs, 10 cm. in length, with a dip of 35° to the north; others are found in that vicinity, with the same inclination. Most of the feldspar presents a waxy lustre (in part due to the paraffin absorbed during the water-proofing treatment in 1885), with occasional cleavage-planes of microcline, showing bright lustre; in places, however, below, the feldspar is often of brownish red rusty appearance. Between the two cartouches of the second row, across the body of the owl, runs a black seam of hornblende-gneiss, two feet in length. A little above a lower cartouche, in the north column, are rusty stains, like those from decomposing pyrite; the feldspar grains are sprinkled with bright red spots; and the surfaces of the oligoclase crystals are dull white and pitted. The bottom of this cartouche is crossed by a lenticular black mass of hornblende-gneiss, dipping about 40° to the north; smaller ones occur beneath. Below this, fresh and bright surfaces of oligoclase were noticed, but it was generally dull and whitened; and indeed the feldspar planes, all the way down this side, are often softer and
more inclined to powder than on the north side. At the bottom of
the shaft occurs the great seam of hornblende, of which the cleft has
now been partly filled with cement.

On the S.S.W. side of the shaft, at the top, the feldspar and mica
appear bright on all the fresh surfaces. About a third of the way
down, near the second row of cartouches, the red microcline, quartz,
and mica continue to be wonderfully bright and glittering; the
feldspar crystals sometimes 3 inches long by \( \frac{3}{4} \) of an inch wide, and
the quartz in occasional flakes, 3 to 4 inches long. A small lens of
hornblende-gneiss, 2 inches long, was seen just below the pyramid-
ion, but none further down. About 22 feet above the bottom of the
shaft, the grains of quartz and feldspar are often bright, and ap-
parently with as few cracks as in any fresh granite; the feldspar crys-
tals are salmon-colored to pink, generally 1\( \frac{1}{2} \) inches long by \( \frac{1}{4} \) to \( \frac{1}{2} \)
inch wide, and some show dull lustre. The white grains of oligo-
clace are here abundant, dead-white and covered with snow-white
films (calcium carbonate?), forming irregular dull spots, \( \frac{1}{4} \) to \( \frac{3}{4} \) inch in length. Many little flakes of black hornblende here occur, ap-
parently as numerous as those of black mica, and often surrounded
by ochreous particles and spots. The scales of black mica are shin-
ing and flat, and never show curling. Along the bottom of the
lowest cartouche, in the east column, near the bottom of the shaft,
the black streaks consist of flakes of black hornblende. A crystal of
microcline was noticed below, with pale altered edge.

In regard to the distribution of the biotite and hornblende on the
four faces of the Obelisk, I found that it varies greatly, biotite in
general largely replacing the hornblende. Where the latter occurs,
it may be alone and scattered in grains, or intermixed and closely
interpenetrated with biotite, or concentrated in large masses, often
lenticular in outline, or thinning out at one or both ends into wedge-
like seams. In these masses, the plates and bunches of hornblende,
as well as of any biotite intermixed, are arranged in nearly parallel
planes; so that, in fact, they present all the features of intermixed
masses of hornblende-schist, more or less biotitic. Still further, the
planes of these schist-enclosures lie very nearly parallel, so that this
obelisk-mass presents to us the last stage of a transition of horn-
blende-schist into a gneissoid hornblende or biotitic granite. The
most extensive of these enclosures of hornblende-schist is that near
the base of the shaft which forms a narrow black seam running up
the W.N.W. face, and, on the E.S.E. face, has in olden time partly
weathered or fallen out and formed the well-known rift or notch\(^1\) at the east base, partly filled and pointed with cement, at the time of the treatment of the Obelisk in 1885.

There is an interesting correspondence, in both constitution and origin, between the rocks of New York Island and those of Syene. The so-called "Graywacke Knoll," on which the Obelisk now stands, consists of biotitic hornblende-schist and gneiss, closely resembling the black seams in the monolith. This mass is crossed by a vein of coarse endogenous granite, very similar in places to that of the Obelisk itself, which is now covered by the western steps leading up to the platform; some branching seams of this granite still project on the sides of the steps. On account of this resemblance, except in the brighter red color and porphyritic character of the Obelisk-granite, a box of fragments of rubbish from this vein was kept at hand by the workmen, at the time of the waterproofing of the monument in 1885, to satisfy the constant demands of visitors from all parts of the country for specimens from the monument, and admirably answered the purpose to the gratification of both parties.

It would appear that the strongly marked bedding, apparent in photographic views of the old quarries at Assouan, and in conformity with which all the obelisks were hewn, is not, at least in all cases, the true plane of original stratification. This bedding plane is shown in the gneissoid structure of our Obelisk and now stands upright in the shaft. But, to the geologist's eye, the New York Obelisk is merely a long block of biotitic, porphyritic granitoid gneiss, in part hornblende, crossed by seams and lenticular nodules of black hornblende-schist, whose lamination (probably signifying the true original bedding) now happens to be set up, so to speak, with a strike of W.N.W. to E.S.E., and a dip of 40° to N.N.E.

3. **Entasis of E.S.E. face of the New York Obelisk.**

While here discussing the locality and original source of the material of Egyptian obelisks, we may refer to one feature of the New York monolith to which my attention was first called by Prof. R. O. Doremus, a slight curvature, longitudinally convex, of its present E.S.E. face. On farther examination, there appeared to me, also, a very slight lateral convex curvature of the same face,

\(^1\) Goringe, op. cit., 12.
from each edge up to a central line; but the opposite (W.N.W) face appears to be plane and its edges straight. The exact determination of this point could not be well carried out from my unsteady position in a swinging boatswain's chair.

A corresponding curvature or entasis has already been noticed in several Egyptian obelisks. In the northern erect Obelisk of Queen Hatsah at Karnak, a decided convexity of at least one of its faces was observed by Verninae St. Maur. In the Obelisk of Thothmeses III, now in front of the Church of St. Giovanni in Laterano, at Rome, of which the shaft is 105 feet 7 inches in height, the western face is slightly convex, and the pyramidal finish at the top has a small convexity on each of the four sides. But the best known and most marked entasis occurs in the two obelisks of Luxor (of which the western is now at Paris). In each, the N.W. and S.E. sides are convex, to an extent of 0.080 and 0.035 meter respectively (1.4 and 1.3 inches), at the middle of the rounding, measured from a straight line across from edge to edge. In regard to the object of this curvature, Wilkinson states: "The faces, particularly those which are opposite to each other, are remarkable for a slight convexity of their centres, which appears to have been introduced to obviate the shadow thrown by the sun, even when on a line with a plane surface. The exterior angle thus formed, by the intersecting lines of direction of either side of the face, is about 30." Both the Luxor obelisks, however, have also a longitudinal curvature of the same two faces, amounting to 0.020 and 0.045 meter respectively, in the Paris Obelisk, that on the N.W. face being convex and that on the S.E. concave. Hence all their longitudinal edges are convex to the N.W., i.e., toward the Nile. By Prof. Donaldson these curvatures are looked upon merely as defects in quarrying, as he states: "I imagine that the first block must have been irregularly marked out and worked, and the second one compelled to follow the faulty line in the quarry."

In regard to this feature in the New York Obelisk and those of Luxor, I think it probable that at least longitudinal curvatures, especially if with corresponding concavities on opposite side of the blocks, may be but instances of tendency to curvature in splitting, commonly observed in natural joints of granite and on the longer

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1 Goringe, idem, 121.  
2 Lebas, idem, 63.  
3 Long, idem, 336.  
4 General View of Egypt, 167.
faces and bedding-planes of its quarries; of this some evidence seems to be shown in photographs of ledges in the Syene quarries.

It may be added that there is abundant evidence in the old quarries of Syene of the great care and economy with which the Egyptians worked their highly prized "heart-stone," and therefore of the probable good condition in which their hewn blocks were delivered ready for transport. But natural flaws occurred in the stone, and the unequal strains produced by rude methods of quarrying may have occasionally resulted in injury to some of the larger blocks, e.g., the apparent cross-fissure in the famous partly hewn quarry-obelisk. Such defect may be now represented in local weakness in parts of the New York Obelisk and others, and in fractures to their pyramids.

The most noted example was the cracked base of the western obelisk at Luxor, discovered, on the arrival of the French, by the hollow sound it yielded to a gentle blow of a hammer. The engineer Lebas, at the time, great dismay and embarrassment, lest he might afterwards be charged to have cracked the obelisk while lowering it from its pedestal. The main fissure was twelve feet in length, running along about one-sixth of the length of two of the faces (as now shown in photographs of the Paris Obelisk). It was "crossed by two dove-tailed mortises, filled with a yellowish dust, the remains of wooden dogs, which must have been driven in, before the erection, to prevent any possible widening of the crack."

4. The nick in the north-northwest edge.

About half-way up the shaft, on the N.N.W. corner or edge, a peculiar deep nick occurs, easily remarked from below, which also appears in all photographs of adjacent faces of the monolith, taken while it stood at Alexandria, previous to 1879. This seems heretofore to have escaped particular attention, doubtless because it has been considered a mere defect, like others of smaller size along that and other edges of the shaft. I had opportunity to examine it with some care, during my trips in the hanging chair up and down the adjacent sides, and found it to possess quite a symmetrical form, that of a quarter section of a hemisphere. The height of the little curved vault of the cavity is 7 inches, and the depth of its floor, measured from the angle (radius of the hemisphere), 5 inches.

1 Lebas, idem, 45.
Through the rock in its vicinity small bunches of black hornblende are scattered, but none on the sides of the cavity. It does not therefore appear to be the result of weathering away and dropping out of any hornblende-mass or of other ordinary products of decay; and its outlines do not conform to the natural cleavage of the stone. Its peculiar shape, and its position—which is, I believe, exactly half-way up the shaft, suggested the possibility that it may have been an ancient artificial cut, perhaps a niche or shrine excavated for the reception of a small golden image of some deity. If so, whether this was done during the construction of the shaft at Syene, or by Egyptian, Greek or Roman, at later date, at An, can now be but a subject of conjecture. No corresponding cavity appears in photographs of other Egyptian obelisks, however, nor in that of the fellow-obelisk now in London.

5. Decay of granite at Syene.

A general opinion has long prevailed that the climate of Syene is one not only of extreme heat, but of unvarying aridity, and that its rocks are consequently fresh and free from any but the most superficial decay.

Thus Jomard,\(^1\) in 1809, refers to Syene as “a place surrounded on all sides by naked and browned rocks; a burning sky, never tempered by a drop of rain. Martial has characterized in a single line this aridity and this sombre color of the ground:

\[\text{Siris quotes Phario madeat Jove fusca Syene.}\] \(^2\)

If you break off a chip from these dark colored rocks, you are surprised to see the rose-colored and brilliant tint which the fracture has revealed. You wonder whether it is the action of the air or that of the sun to which the surface owes its brown and deep color. But what could an atmosphere of perpetual dryness produce on so hard a material? And, as to the heat, one can hardly attribute this effect to it, except on the supposition of a period of prodigious length; because the hieroglyphs inscribed on these rocks for a long time are still of a quite bright rose-color.” Elsewhere he explains that the wedge-marks and hewn surfaces in the granite quarries still retain the same bright color. Lefèvre,\(^3\) in 1838, refers to the more ancient syenite forming “cliffs resembling heaps of

\(^1\) Jomard, op. cit., I, ch. ii, 61.  
\(^2\) Epigramm, Bk. IX, epigr. 36.  
\(^3\) Lefèvre, loc. cit., 144.
rounded altered blocks," and Delesse also states, ¹ "Near the cata-
ract, the separated blocks of syenite have sometimes a spheroidal
form, and they disintegrate in concentric layers." Lieut. Newbold
also reports: ² "The granite of Egypt is freer from the decay, the
maladie du granit, than that of India, arising probably from the
peculiarly dry atmosphere of Egypt, which has been mainly instru-
mental in preserving, almost in their original freshness, its magnifi-
cent sculptures and vivid frescoes."

As to the climate, however, there is abundant evidence of past
exaggeration of its arid character, and of the occurrence of heavy
falls of rain, though at long intervals, as well as of the constant
heavy dews. These render it certain that the action of water in
erosion, infiltration, and hydration has ever played a slow but
important part in effecting decay of the rock in that region.

For example, Lepsius relates, in his account of travel through
Egypt, that he encountered at Assouan a violent thunder-storm,
with heavy rain, which afterwards rolled down the Nile valley for
nearly 600 miles, as far as Cairo.³

Concerning the Libyan hills, Ebers also states: ⁴ "From time to
time—rarely indeed, and in most cases only once a year, in the
winter months—dark storm-clouds gather around the heads of the
mountains; and soon the rain pours down with such violence, on
the hill country, that it seems as if all the collected vapors of the
year were being restored to the earth in one tremendous torrent.
The brooks and cascades that tumble down the rifts and crevices in
the mountains collect in the valleys; the streams form a regular
system of little rivers; and at last, gathering in one main valley,
the flood rolls on, either slowly and majestically, or vehemently,
ruining all it meets with on its way, till it loses itself in the Red
Sea or the Nile."

Further data on this subject are given beyond, in the notes on
the climate of Alexandria (Section 11).

It is also apparent, by a study of views and photographs from
this region and of references to its scenery by passing travellers,
that the picturesque character of the vicinity of Syene is mainly
due to the extent and character of general rock-decomposition
which there prevails. Thus Denon, ⁵ in 1802, describes the scenery

¹ Delesse, loc. cit., 488.
² Newbold, loc. cit., 340.
³ Lepsius, Letters from Egypt, 119.
⁴ Ebers, op. cit., II, 333.
⁵ Denon, op. cit., 83.
near the First Cataract: "These mountains, all bristling with black and sharp projections, cast their sombre reflections in the waters of the stream. . . . After passing the cataracts, the rocks grow loftier, and, on their summit, blocks of granite are heaped up, appearing to cluster together and to hang in equipoise, as if with the purpose of producing the most picturesque effects. Through these rough and rugged forms, the eye all at once discovers the magnificent monuments of the Island of Philae." Miss Amelia B. Edwards\(^1\) also refers to the same scene: "Perhaps the most entirely curious and unaccustomed features in all this scene are the mountains. . . . Other mountains are homogeneous and thrust themselves up from below in masses suggestive of primitive disruption and upheaval. These seem to lie upon the surface foundationless; rock loosely piled on rock, boulder on boulder; like stupendous cairns, the work of demi-gods and giants. Here and there, on shelf or summit, a huge rounded mass, many tons in weight, hangs poised capriciously."

The peculiar features which mark an extensive, deep and long continued decay of rock in place are well shown in the accompanying illustration, from a photograph made by my friend, Dr. H. Carrington Bolton, of a granite-cliff about 2 miles south of Syene (Pl. IV). We have here all the indications of a slow decay, progressing most rapidly along the planes of bedding and jointage, also eating out the latent lines of shrinkage and weakness, and so dividing the whole mass into angular fragments, with slight adherence, only remaining in place by gravity, like the boulders in a stone-wall. Exfoliation has partly rounded the angular blocks at their corners and edges, even in position; while those on the crest, and those that have rolled out into full-exposure to sun and to night-radiation, have been largely rounded off into true boulder form.

[At this point a series of recent photographs was exhibited, including the following: View of the First Cataract from the S.W., with deeply etched and roughened boulders and tops of columns, on the crest of the cliff in the foreground: View of an old watch-tower near Syene, showing horizontal bedding and strong joints in the cliff, and several well rounded boulders, with surface scaling off in successive coats: Frith's view of Philæ, from the head of the cataract, on the north, showing the deep erosion of the strong joints,]

\(^1\) Edwards, op. cit., 231.
and etched surfaces of rounded boulders, near the level of the river: Views from Philae to the N. and to the S.W., showing development of columnar structure by the decay, in the direction of the strike, and formation of elongated boulders: Views of Philae from the E. and from the S.W., showing the eroded columns of "Pharaoh's Throne," rounded ledges, with hard seams (of quartz?) projecting above the eroded surfaces, and huge exfoliating boulders.

These forms are so familiar to the geologist's eye, as characteristic of rock-decomposition in a climate of heavy rainfall and winter frosts, that it is at first hard to believe that these occur in one of the most arid regions on the globe, where frost is unknown. The topographical features suggest the probability that, throughout the entire upper stratum of granite, to which the Egyptian quarrymen were compelled to limit their exploitation, not exceeding a thickness of 60 or 70 feet, the stone was already quite uniformly affected by a kind of "dry rot." Further light on this matter will be presented beyond, in physical tests made on the freshest stone I have been able to procure from the Assouan quarries.

To Villiers Stuart we owe an archaeological observation at the First Cataract, whose geological importance seems to have been overlooked: "We landed at the island of Schael, just below the falls, to examine the inscriptions on the rocks; they are very numerous and curious, and extend over a period of 2000 years. The earliest we saw was of Ousertasen the Third, of the XIth dynasty (2200 B.C., Lepsius) . . There is a special interest about Ousertasen's, for it was inscribed while the Nile was still at its original level, 23 feet higher than now; and accordingly it stands high upon the rocks . . . They are all cut in granite, and Ousertasen's showed its great age by the fact that a process of decay in the granite itself had set in, the once polished surface being corroded and eaten by the tooth of time, and the outlines somewhat blurred. High up among the loftiest rocks of the island, however, I found another inscription and a statuette cut in bold relief in a niche which must have been much older even than Ousertasen; the granite had so entirely decayed that the features of the statue had dissolved and were undistinguishable. There were many lines of hieroglyphics in like manner quite decayed and illegible. No clue therefore existed to the date except the condition of the stone,

\footnote{Nile Gleanings, 263.}
which, though in a sheltered angle of the rocks and less exposed than Osertasen's, was much further gone. It may have been of the Pyramid period" (IVth dynasty, 3124–2840 B. C., Lepsius). This would involve an exposure of 50 or more centuries.

On the other hand, Delesse states:¹ "In the Egyptian Museum of the Louvre, the feet and the head of the colossal statue of Amenophis III, as well as a large number of sculptures, which, under the perpetually pure sky of Egypt, have not experienced any alteration during the greater part of the time, have even preserved the most perfect polish after nearly 4000 years."

From all these observations at Syene, the following conclusions may be drawn:

(1) The predominant destructive process has not been external, such as disintegration by the heat of the sun, attrition by sand whirled by the wind, etc.; here, as elsewhere, these have played a secondary part. A certain degree of polish has been produced on the surface of ledges by sand-attrition, by occasional heavy rains, and by the mud-laden waters of the Nile up to the limit of its flood-line.

(2) The main process has been one of internal decay, most efficient along the joint- and bedding-planes of the granite, even to the lowest depths now observable, and producing long columnar masses. The chemical decay and disintegration have also seriously attacked the irregular planes of contraction and eaten them out into an irregular network of fissures, which mark the latent lines of weakness throughout the material, and divide it into angular blocks.

(3) The gradual decomposition of the ferruginous silicates over the surface of the ledges (biotite, hornblende, and the feldspars) has left their feebly soluble bases, in this arid climate, as a polished black crust of iron and manganese oxides. The other more soluble and finer products of decay have been removed by occasional rains and constant action of the wind.

(4) The outer forms assumed by the cliffs largely indicate their variation in materials and in their resistance to decomposition and erosion: the projecting masses consist of the more compact kinds of granite and porphyry, and even thin projecting seams and nodules of quartz: the hollows and fissures, of softer granite and of intercalated seams of hornblende-schist. A considerable internal expansion of material is shown by the general scaling of the surface and

¹ Delesse, loc. cit., 490.
rounding of angles and edges. The predominance of these rounded forms in loosened and isolated blocks, and in the projecting tops of columns, probably signifies the efficient help of the heat of the sun and of alternations of temperature.

(5). As to the amount of degradation of the surface, we may probably get some estimate through the observations of Stuart on the effacement of the older hieroglyphs on the island of Schael. Since the ordinary depth of such carvings is from 2 to 4 centimeters, we may infer that the granite has decayed in these places, during the period which has elapsed since their execution, from 40 to 50 centuries, to the depth of at least 1 centimeter and perhaps over 2 centimeters.

It must always be a subject of regret that Commander Gorringe, during his stay at Alexandria for the removal of our Obelisk, was not able to visit this region and to become impressed with the universal and deep decay prevailing throughout this durable rock of Syene. In that case, it is probable that he would not have replied, as in 1880, to a suggestion of the need of the New York Obelisk of protection from the weather by some preservative: "It has lasted nearly 4000 years and will probably last 4000 more. I think we need not trouble ourselves about it."It was but a repetition of the mistake of his predecessor, Rameses II, who, in his invocation to the gods, recorded in the poem of Pen-ta-our, alludes to the "eternal stones" which he has erected in his temples to their honor.

II. An.

The next step in the history of our Obelisk was its conveyance from Syene to the ancient city of An (or Heliopolis, as the Greeks called it), near the site of the present Arab village of Mataria, about 6 miles N.E. of Cairo.


This city of An was built upon a somewhat raised, artificial platform, extending over an area (according to Mariette-Bey) of about 4560 by 3450 feet. Here our Obelisk, together with its companion, now in London, was raised before the Temple of the Sun by Thothmeses III of the XIXth dynasty, about the year 1600 B.C. As

1 Report on Condition of Obelisk, 4.
to the situation of the great Sun Temple, and of the great gate or propylon standing before it, archeologists agree in assigning it to the western part of the city, toward the Nile and the setting sun. The English traveller, Pococke, in 1743, traced out the boundaries of the mounds, as indicating the outlines of the ancient city. Brugsch, however, maintains that these mounds show only the limits of the walls of the temple, and are themselves but the remains of the walls of a Coptic town which occupied the site of the temple, a few centuries before our era.

The temple was specially devoted to Atum-Ra or Tum, the God of the Setting Sun. Before the great propylon, in approaching it from the west, rose a pair of Obelisks of Useresken I of the XIIIth dynasty, probably erected about 2300 B.C., fully 700 years before our own monolith. Pococke located these almost opposite to the passage through the mounds which he considered to be the west city gate, but a little more to the south. One of the pair fell in 1160 A.D., having been undermined by treasure-hunters, and has long disappeared. It was perhaps last seen prostrate in 1753 A.D., by Robert Clayton, of the present erect shaft, Savary stated in 1787, "this and one sphynx of yellowish marble, thrown in the dust, are the only remains of Heliopolis."

Passing next through the propylon and between two rows of marble sphynxes, the temple itself was reached, with two pairs of obelisks before it. The pair next the portal of the temple was the more ancient, consisting of the monolith which now stands at Constantinople (the Atmeidan Obelisk, with its lower end broken off, but still 55½ feet in height), and of a missing companion, of whose fate nothing is now known. The outer pair consisted of the obelisk now at London, on the right (S.W.), and of our own Obelisk on the left (N.E.).

7. Orientation of sides of our Obelisk at An.

In regard to the position in which the sides of the Obelisk were then placed, a consideration of the inscriptions within the pictured squares on the four faces of the pyramidion throws some light. In those of the present N.N.E. and E.S.E. faces,4 the King Thothmeses is represented in the form of an androspyinx, worshipping the God of the Rising and Noon-day Sun, Hor-Khuti-Ra. In the

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1 A Journal from Grand Cairo, 7.  
2 Savary, op. cit., I, 123.  
3 Moldenke, op. cit., 54 and 47.
pictures of the S.S.W. and W.N.W. faces\(^1\) of the pyramidion, the object of the king's worship is Atum-Ra, the God of the Setting Sun, to whom the Sun Temple at An was specially dedicated, at least during and after the XIIth dynasty, by the re-builder of the sanctuary, Amenemhat I. In harmony, therefore, with the purpose and custom of the sun-worship, the former two faces must have been originally so placed, on the erection of this shaft at An, as to have been lit by the rays of the rising sun, and the latter two, by those of the setting sun. The similar pictures on the pyramidion of the London Obelisk intimate that its faces were arranged in a corresponding position. Indeed the same key to the position of their faces is afforded by the similar pairs of pictures on the faces of the pyramidia of several other obelisks.

A more definite indication is probably shown in the position of the faces of the present Obelisk of An, which probably stood in front of the pylon of the Sun Temple, at a site more westerly than that of the New York and London obelisks. As to this, Niebuhr has noted that its angles are now directed to the S.S.E., N.N.W., E.N.E., and W.S.W.\(^2\) Archæologists, however, have pointed out the evidences of a historical catastrophe, in early Egyptian history, unrecorded in the inscriptions, during which, perhaps by a great revolution or invasion, all the monuments, temples, and obelisks of Lower Egypt were overturned; some writers attribute it to invaders, such as the Hykshos, 2398 B.C.\(^3\) Some of the monuments have ever since lain prostrate, e.g., the stela of Begig of Usertesen I, in the Fayoum. Others, like this Obelisk of An and its former companion, were afterwards re-erected by the Egyptians. Their ancient low pedestals, consisting of a layer of sandstone blocks, had been probably undisturbed, and probably guided their re-adjustment in their former and proper position. The evidence of this surviving obelisk on the site of An is therefore that the front of the pylon, the façade of the Sun Temple beyond, and the corresponding western faces of all its six obelisks (if Niebuhr's observation is exact), faced to about W.N.W., i.e., W. 22° N.

We have evidence, in the ancient documents, of a ceremonial attending the foundation of an Egyptian temple, which signified a deliberate design as to the direction in which it was to be laid out;

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\(^1\) Moldenke, idem, 50 and 52.  
\(^2\) Long, idem, 315.  
\(^3\) Cooper, idem, 17.
in this, the King and the God are represented holding stakes upright between them, around which a looped cord is drawn tightly, so as to indicate a definite direction; along the line then shown by the stakes, driven into the ground, a boundary wall of the new temple was erected. In an inscription dating over 2000 years B.C., this ceremonial is related concerning the foundation of this very Sun Temple at An, by the founder of the XIIth dynasty, Amenemhāt I, and his son and co-regent, Usertesen I, who afterwards set up the present Obelisk of An:

"Arose the King, attired in His necklace and the feather-crown; All the world followed Him, and the Majesty of Amenemhāt. The Kolchyt read the sacred text, during the stretching of the measuring-cord and the laying of the foundation-stone on the piece of ground selected for this temple. Then withdrew His Majesty Amenemhāt; And King Usertesen wrote it down before the people."

As to the intent of the particular direction given to the measuring-cord, we now have a satisfactory explanation through the investigations of Nissen, in 1885, and of Lockyer (op. cit.) in 1891. The varying courses of the axes of different Egyptian temples appear to have been directed to points on the horizon which marked the periodical rising or setting of the sun, moon, or certain stars, particularly at the summer and winter solstices. The apertures in the huge pylons and in the series of separating walls and portals beyond, toward the Holy Place, exactly represent the diaphragms in the modern telescope, and were intended to keep the light pure, from the luminary rising or setting on the horizon, and so lead it directly into the sanctuary at a definite moment. A solar temple was therefore so oriented to the horizon, at a solstice, that, either at sunrise or at sunset, the light of the sun should pour along the axis from end to end. Several of the solar temples were thus directed toward the point of the setting sun at the summer solstice, when the day was longest; and to this class, of course, must have belonged the Sun Temple of Atum-Ra at An. There, once a year, past its double emblem before the pylon, the pairs of obelisks, the sunbeam sped through the huge portal, through the double line of sphynxes and the colonnade of temple-columns, through opened doorways and parted curtains, and flashed through the portal of the dark Holy of

1 Rheinisches Museum für Philologie, 1885.
Holies as a glittering spot of light upon the end-wall—for a few moments only, it may be, and then vanished away. So began the first day of Thoth, the first month of the Egyptian year. The orientation of the axis, over a quarter mile in length, of the magnificent Solar Temple of Amen-Ra, at Karnak, has been determined with an amplitude of W. 26° N.,1 and that of Abydos, W. 27° N. The latitude of Karnak is about 26° N., and that of An about 30° N., which (according to an approximate calculation made for me by Prof. J. K. Rees, of the Astronomical Observatory at Columbia College, New York) would add about one degree to the amplitude of the sun-setting point at the summer solstice.

Although, therefore, not a single stone remains of the ancient Sun Temple of An, it appears quite certain that its axis was directed to W. 27° N., and to that point faced the front side of the New York Obelisk, over thirty-five centuries ago.

8. The mutilation of the Obelisk by fire.

After standing, probably undisturbed, for about 1050 years, the Persian Invasion of Egypt occurred, during which, about 525 B. C., the city and Temple of An were destroyed, as related by the geographer Strabo,2 who visited Egypt 24 B. C.:

"There, too, is Heliopolis, situated on a large mound. . . . At present the city is entirely deserted. It has an ancient temple constructed after the Egyptian manner, bearing many proofs of the madness and sacriligious acts of Cambyses, who did very great injury to the temples, partly by fire, partly by violence, mutilating in some cases and applying fire in others. In this manner he injured the obelisks, two of which that were not entirely spoilt were transported to Rome. There are others, both here and at Thebes (the present Diospolis), some of which are standing, much corroded by fire, and others lying on the ground."

There are two reasons for believing that our Obelisk and its companion would particularly attract the fierce indignation and attack of the Persians, perhaps above all the others which gave to the city its name of the "City of Obelisks:" first, their prominent position before the façade of the Temple of the Sun; secondly, the names of the two kings repeatedly inscribed in cartouches, among the hieroglyphs over every side of these two shafts.

1 Compare Map No. 1, Wilkinson, Thebes and Pyramids.
2 Book XVII, i, 27.
To the westward, for reasons before explained, the present W.S.W. angle of our monolith must have been directed, so that, to one who approached the Temple, the inscriptions on the present S.S.W. and W.N.W. sides first became visible. This conspicuous position might have been sufficient in itself to invoke the special fury of the destroyer. But to this must have been added the intense hatred of the Persian toward the two warlike and ambitious monarchs of Egypt, Thothmeses III and Rameses II, who had both in succession, at an interval of two centuries, not only extended the sway of Egypt over Persia, but had subjected the native land of the present invader, Cambyses, to special cruelty and humiliation. We may then fairly infer that the fires must have been the hottest and longest continued, and the utmost efforts at mutilation most persistent, toward this Obelisk and its mate, on which the cartouches of these Pharaohs, constantly repeated and glittering with gold, caught the Persian eye. Such fires would be specially kindled and fed on the two prominent faces of our Obelisk, above designated. The lesser injury to the Obelisk of Usertesen, before the pylon, is thus explained, reaching merely for a few yards above its base.

What evidences of such violence, then, still remain upon our own Obelisk?

(1). The strange condition of the pedestal. It has probably resulted from the development of the bases of nearly all the obelisks, in Upper Egypt, by sand, as at Luxor and Karnak at Thebes, and, in Lower Egypt, by mud from the overflow of the Nile, that but little is known in regard to their pedestals.

At Luxor, the excavation of the bases of both the obelisks of Rameses II, which preceded the removal, by the French engineer, of the western obelisk to Paris, revealed, beneath each shaft, an elaborately sculptured granite pedestal, resting upon a platform of three blocks of sandstone. The monolithic pedestal (see figure in my paper, Misfortunes of an Obelisk, loc. cit., page 99), which originally stood under the western obelisk and was left behind by the French, was decorated with figures of pairs of cynocephali or apes (representing the god of wisdom, Thoth) on two opposite sides, and, on its face, with figures of the Nile god, Hâp, presenting offerings to Thoth, and with rows of hieroglyphics, once probably filled with gold; this block was 26 meters (10 feet) in height.

1 Lebas, idem, 71.
The other pedestal, beneath the eastern obelisk of Luxor, and now buried in sand twenty feet deep, out of sight, was 3.4 meters (11\(\frac{1}{2}\) feet) in height, sculptured and decorated in the same way.

At Karnak, the standing obelisk of Queen Hatasu, the sister of Thothmeses III and his predecessor on the throne, has a low square pedestal, whose sides are covered with rows of hieroglyphs, also probably filled with gold like those on the shaft above.\(^1\)

The Corfe Castle Obelisk, formerly on the Island of Philae, has a sandstone shaft, 22 feet and 1\(\frac{3}{4}\) inches in height; its sandstone pedestal is 5 feet 9 inches in height, and covered with Greek inscriptions of Ptolemy Euergetes II, in part cut in the stone, and in part painted upon it, or, according to Cooper, originally written in letters of gold.\(^2\)

The Obelisk of An, according to Lenormant, stands upon a simple foundation, now buried several feet beneath the Nile silt, consisting of two broad steps or slabs of sandstone, each about 2 feet high;\(^3\) but, on account of its ancient disturbance, we have no certain knowledge concerning its original support.

In regard to the Campensis or Monte Citorio Obelisk, at Rome, which the Romans tried to use as a sun-dial, it was stated in 1803, “there can still be seen at Rome the original pedestal of the horary obelisk overturned on the Campus Martius,” and also that there was in the Vatican “a granite base cut with a cavity, probably to receive an obelisk.”\(^4\)

Note the singular fact, however, that we find the huge granite pedestal of the New York Obelisk devoid of sculptures, inscriptions, or even polish; its sides approximately even, but with roughened surface; its edges and angles nicked and uneven; its corners greatly rounded off; and many large spots, showing internal cracks by their hollow sound, when lightly tapped. Yet the shaft above shows amusing evidences of the struggle of two successors of Thothmeses III on the throne of Egypt, Rameses II and Osarkon I, to find sufficient room on which to record their inscriptions of self-appreciation; while apparently there were over 220 square feet of blank space waiting for glory on the pedestal below. It seems more than a probability that this pedestal, in its original condition at An, was completely covered with hieroglyphs.

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1 Lepsius, Denkmäler, Plate 24.  
2 Goringe, idem, 139.  
3 Goringe, idem, 123.  
4 Quatremère de Quincy, De l’Architecture Égyptienne, 198, 108.
and sculptures, like those which Rameses II had carved upon the pedestals of his fine monoliths at Luxor; that their entire disappearance, succeeded by a roughened surface, points to the violent mutilation and fire of the Persians: and that, at the time of its transfer to Alexandria, the Romans were content to dress the damaged faces somewhat, to an even surface, rather than to cut new figures or hieroglyphs into the hard granite; of their poor work in imitation hieroglyphs, they have left us samples in some of their own obelisks at Rome.

A corroborative fact is found in the pedestal of the fellow-obelisk, which the English left buried in the sand at Alexandria. As this consists of limestone, it seems likely that the original granite pedestal of that shaft at An was found by the Romans so badly injured or destroyed, that they replaced it at Alexandria with a block of the easily hewn and abundant material, limestone, from the quarries beyond the Nile, adjacent to Heilopolis, at Masara or Turra.

(2). The extreme mutilation of the bases of the two shafts (and these only, of all Egyptian obelisks), particularly at their corners. These are so greatly and irregularly rounded off, that Gorrinse estimated that not over two-thirds of the area of the bottom of our Obelisk could come into contact with its pedestal. So great is the rounding on the heel of each shaft, that one old writer, in 1738 A.D., describes it as hemispherical, fitting into a corresponding cavity or hollowed-out socket in the pedestal, and states: "but the Basis or Foot may perhaps be the most remarkable Part of these Obelisks, especially if that at Alexandria is to instruct us. . . . They would bear a nearer resemblance to Darts and massive Weapons, thus more expressive of Rays of the Sun."1

As Gorrinse states, "that marring of the heel, to the extent of breaking off large masses at the corners, cannot be attributed to the present age. The fractures are also too irregular to admit the theory that they were purposely broken off to facilitate the operation of raising the Needle."2 The mutilation must have occurred before the erection of the Obelisk at Alexandria, since the Romans then found it necessary to introduce their bronze crabs as supports beneath the four corners. According to one author, "one effect of the removal of the obelisks by the Romans was to break off the

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1 Shaw, op. cit., 411. Also Pococke, op. cit., I, 7.  
2 Gorrinse, idem, 192.
edges at the bottom. . . . During the transportation, a large portion of the edges at the base was very badly damaged. Such rude and clumsy handling, however, is not likely, in view of the known skill of the Roman engineers: their experience twelve years before, according to Strabo, in conveying a pair of obelisks from Ax to Rome: and the perfect condition of the bases of the Egyptian monoliths now in Rome, and, in fact, that of the delicate pyramideon of this very Obelisk. The mutilation must have occurred at Ax, and it is significant that it occurs, in both obelisks, in just that part of the shaft which must have been most exposed to the fire. If the obelisks were then overturned, the injury may have been intentionally increased by mechanical violence.

It is also highly probable that the destructive action of fire was aided by dashing cold water upon the heated stone, as far up as it could be thrown from below, a method of destruction of rock well known to all the ancient nations, and commonly used in their mining.

(3). The partial to complete obliteration of a large portion of the inscriptions on all sides of the base of the shaft, with a peculiar smoothing of the surface, up to a height of 10 or 12 feet above the top of the pedestal. The upper limit of this, the so-called "sand-line," running horizontally around the shaft, begins on the N.N.E. side, about half-way between the two lowest rows of cartouches. In addition to the effacement of hieroglyphs, the peculiar even and shining surface should be noted, which is, to a large degree, free from the pitting, often deep, which covers the surface of the shaft above the line. On the E.S.E. and S.S.W. faces, the same rounding of corners and edges of the hieroglyphs occurs. But on the W.N.W. face, many sharply carved intaglios remain but little injured, near the bottom of the shaft and for a yard above; thence the same rounding and partial effacement of characters extend up to the same line. All these facts point to an ancient destruction of the lower surface of the shaft by some agency which left it covered with smoothly cleaved planes and broken corners, and to a subsequent protection of the smooth surface from the weathering which caused the pitting above the line.

It is known that at least as far back as the visit of the traveller, Paul Lucas, to Alexandria, in 1714 A.D., the shaft was buried in

1 Moldenke, idem, 28, 39.
sand up to the height of 12 feet, and to its action the obliteration of the characters has been attributed by some, the upper limit having been denominated the "sand-line." But envelopment in sand has served usually, in Egypt, as the best protection. Thus it is stated of two of the most ancient obelisks discovered, those of King Entef of the X1th dynasty, over 2400 B. C., "the hieroglyphics in these obelisks were very well preserved, owing to the friendly protection of the sand beneath which they were buried." The same protection of hieroglyphs, on the under side of the fallen obelisk at Alexandria, was noticed at the time of its exhumation in 1801. The same fact may be even more strongly shown in the remarkable preservation of the Greek and Latin inscriptions upon the bronze-crabs, during nineteen centuries, among whose characters, only partly filled with metallic oxides, the keen eye of our American archaeologist fortunately detected the important lost numeral.3

The upper line which bounds most of the obliteration seems to me therefore, perhaps, to mark the highest limit of the most intense flames of the fires at An, and more surely the limit of protection of this smoother fire-flaked surface, from much subsequent erosion and pitting by the weather and drifting sands, during its envelopment to that depth.

(4). The belts of obliteration which stretch up the S.S.W. and W.N.W. sides of the shaft, uniting in the cracked W.S.W. corner. This effacement of hieroglyphs has been attributed to several causes.

(a). The damp climate and sea-breezes of Alexandria. This will be discussed beyond, where it is shown that the side which then faced the Mediterranean is the present E.S.E. side, on which the inscriptions remain in excellent state of preservation.

(b). The long continued action of the sun. This view appears at first the more plausible, since it is probable, for reasons already given, that the badly injured W.N.W. and S.S.W. faces did really stand at An for about 1050 years, as they do now, in full exposure to the afternoon sun. But the present N.N.E. side faced the sun afterwards still longer, at Alexandria, for 1891 years, to the W.S.W., and is the best preserved of all the faces. Nor has such injury been noted on any other of the obelisks, constructed of exactly the same granite, which have stood, in the same climate, at An and at

1 Stuart, Nile Gleanings, 273. Long, idem, 302.
2 Merriam, loc. cit.
3 Clark, op. cit., 31.
Thebes, for still longer periods. The present Obelisk of An has remained on its site, only a few rods distant from that of our Obelisk, for at least 700 years longer, since about 2300 B.C., and the condition of its surface may throw light on the present question. In 1743, a traveller reports: "It is discolored by the water to the height of near seven feet. It is well preserved, except that, on the west side, it is scaled away for about fifteen feet high."

In 1755, Capt. Norden states: "I have represented the western side of this obelisk, because it is the best preserved. I should further state that the bottom of the obelisk on the east is almost entirely ruined, to such an extent, that almost no trace of a hieroglyph can be distinguished upon it."

In 1787, Savary remarks: "The obelisk is in good preservation except toward the southwest, where the granite is chipped to a certain height." These travellers show the usual careless designation of the decayed side; Niebuhr found that the sides faced N.N.E., E.S.E., S.S.W., and W.N.W. No evidences of present decay and scaling are on record, after an exposure of 45 centuries.

As to the obelisks at Luxor, erected about 1350 B.C., before the pylon of that Temple, and fronting N.W., Pococke reported: "The hieroglyphics are cut in with a flat bottom, an inch and a half deep; and the granite has perfectly retained its polish, which is the finest I ever saw. . . . They are exceedingly well preserved, except that about half the pyramid of the western obelisk is broke off, and the southwest corner of the eastern one is a little battered for about six feet high." The one still at Luxor, and also that of Queen Hatasu at Karnak, remain renowned for the perfect sharpness and exquisite polish of their hieroglyphs, even on the sides which have faced the afternoon sun, undisturbed, for 32 to 35 centuries.

In regard to the stela of Begig, in the Fayoum, which lies, fallen and broken, about 43 feet in length, erected also by Neterseen I, Pococke observed, that "the obelisk is much decayed all around, for ten feet high, but mostly on the south side; the west side is almost entirely defaced."

(c). Attrition by the whirling sands of the desert. On this, a writer remarked, in 1847: "The obelisk that is still erect among the ruins of Alexandria retains much of the freshness, sharpness,
and high polish of its first execution on its north and east faces; but the minute particles of sand with which the air is charged, in passing over the desert, have entirely defaced its south and west sides, by beating against it during the 1600 years in which it has stood in its present position."

In favor of this view is the fact of the greater injury on the present S.S.W. and W.N.W. sides, those which fronted the Khamseen, which, in Egypt, blows at intervals from the S. and S.W., driving fine sand, though seldom for more than a day in duration.

But, even on these sides of the shaft, the deepest injury is at the upper part of the W.S.W. corner, most out of reach of flying sand, and of a different character from the superficial erosion effected by that agency. It was only during the last few centuries that the obelisks have been exposed to sand at Alexandria, having been previously protected within the wall of the city; while, at An, the sands of the desert have never reached their site.

The excellent condition of the partially sand-enveloped obelisks of Thothmes I and of Hatsau at Karnak, and of Rameses II at Luxor, show how limited is the erosion attributable to this agency, as well as to the heat of the sun, on Syene granite, during long periods.

(d). Disintegration by nitrous efflorescence. Injurious action of this origin was noticed in 1809 by Hamilton, on sandstone from the quarries at Hadjar Silsilis: "The rock, in which these quarries have been excavated, is a very uniform, compact granular sandstone, enclosing sometimes lignaceous petrifications. It is extremely hard when exposed to a dry climate and a warm sun, but easily softened by rain, so as to be damaged when moist by whatever touches it too rudely. The exterior of those temples which have been built of it preserves a very clear sandy color; but the walls of the inner apartments are blackened by the confined damp, and by the action of the nitre with which the air is impregnated. In these rooms, the surface of the stone is easily detached in thin flakes."

In his study of the Great Temple at Karnak, Mariette-Bey observed, in 1875: "Every year the river penetrates it by infiltration, and, uniting with the saltpetre with which the soil is impreg-
nated, corrodes and eats away the foundations of the monument. The Grand Temple holds itself up, only because it is supported by the soil in which it is plunged. Naturally there is not a temple in Egypt where the fall of walls happens more frequently."

Elsewhere, he repeats: "For many years the grand Temple of Karnak has been assailed, more than any other Egyptian temple, by the infiltration of the Nile, whose water, saturated with nitre, eats away the sandstone;" and again, "Karnak has found its principal enemy in the nitre that corrodes the base of its walls."

Dr. Rossiter W. Raymond has also called my attention to the deep disintegration and scaling away which he observed at the bases of the great pillars in this Temple, and which can also be readily distinguished in some photographs. My brother, Rev. Matthew C. Julien, recently in Egypt, informs me that he also observed the same scaling on the vertical walls at the entrance of the Serapeum.

There can be no question of the decay and serious damage which have been caused, in Egypt, as elsewhere, by efflorescent salts, but, in that country, only on porous sandstone, in enclosures whose soil is saturated with these salts in the immediate vicinity of filthy Arab villages, and to a height of but a few feet above the ground, rarely over a yard.

Therefore, although an early description of ancient Alexandria refers to its "battlements decayed and the stones corroded and disfigured by saltpetre," there is no evidence nor probability of any granite obelisk having suffered exfoliation from this agency.

(c). Erosive solution by the Nile-waters or Nile-mud. This theory, often suggested, of attack by the Nile-waters, or by organic acids of the rich black soil of the Land of Cham, I think, has not been supported by observed facts. No such decay surrounds the shaft of the Obelisk of Heliopolis. Its base was found, by the French expedition in 1807, to be buried in the alluvial plain to the depth of 1.88 meters (6 feet, 2 inches), of which Wilkinson found that 5 feet, 10 inches had accumulated during the last 1700 years. The actual rise of the waters was found to have reached 1.52 meters higher (5 feet), but no corresponding band of exfoliation is noted.

Nor have the carved flutings and hieroglyphs suffered in sharpness, on the colossal statue of Rameses II, once erected before the

1 Karnak, 7.  
2 Monuments of Upper Egypt, 180, 197.  
3 Volney, op. cit., I, 5.  
4 Histoire Naturelle, Texte, I, 407.  

* Annals N. Y. Acad. Sci., VIII, July, 1893.--9
Temple of Ptah at Memphis, which has since lain buried in the Nile-mud, face downward, for over twenty centuries, until its recent exhumation near Cairo.

Even though we grant, in the absence of proof, that our Obelisk was overturned in the destruction of the Temple at An, about 515 B.C., it seems impossible that five centuries of burial in the soil could have effected the damage we now see upon its faces.

(f). The burning of the stone by the Persians. This appears to me the only satisfactory theory to account for the great injury to the S.S.W. and W.N.W. sides of the shaft. The fiercest flames of the Persian fires, naturally kindled at the most prominent W.S.W. angle, seem to have licked up the adjacent faces, and were probably aided by throwing water upon the heated stone. With the flaking away and fall of the lowest of the hated cartouches of Thothmeses and Rameses from those sides, and the blackening of the rest, the Persian vengeance was sated.

A consideration of all these facts has led me back to the old view, which was thus readvanced, some years ago, by Dr. W. C. Prime: "It is hardly to be questioned that this ancient destruction of the surface was due to the fires of Cambyses, before the stone was transferred to Alexandria. It is probable that, when so transferred and erected in front of the Sebastion, the best preserved side was placed in front, facing the sea. That the monolith was once subjected to severe fire, especially affecting the lower part, and more intense on one side, seems very probable." If also overturned and prostrate for five centuries, as some believe, it may have so fallen as to have buried its present N.N.E. and E.S.E. sides, with its summit under the sand, its heel exposed to mutilation, and its present S.S.W. and W.N.W. sides mainly uncovered to the action of the weather, down to the line now marked by the preserved eastern column of hieroglyphs on its present S.S.W. face.

Our conclusion also confirms that of Denon, at his examination of the two obelisks in 1801: "Inspection of the actual condition of these obelisks, and the fractures which existed at the very time when they were erected on this site, prove that they were already fragments at that period, and transported from Memphis or Upper Egypt."
III. ALEXANDRIA.

In the year 12 B.C., the New York Obelisk and that of London were conveyed by the Romans to Alexandria, probably on a float through a canal and down the Nile, and re-erected near the seashore on the New Port, to ornament the approach to the Cæsareum or Sebastion. There is little likelihood that they suffered any injury while in the care of the skilful engineers of a nation so experienced in the handling of architectural materials, a care exemplified by the elaborate bronze cranes devised and introduced under each shaft, to ensure its permanent support and safety.

The substitution, already suggested, of a limestone pedestal for the ruined granite block which probably supported the London Monolith at An, suggests also that the present limestone foundation of our own Obelisk, with its various enclosures and the substratum of sandstone blocks, may not be of the same age as the pedestal and shaft above, but more likely Roman. Limestone has been the easily quarried, abundant, convenient, and cheap building-stone of Lower Egypt, in all ages; and the limestone blocks in the three tiers of the foundation retain a suspiciously new look and wonderfully sharp arrises, to have passed through the fires and mutilation of An.


On its new site, it was shaken by at least the two recorded earthquakes of 1391 and August 8, 1363, A.D., one of which was sufficiently violent to hurl down its companion. Later, it shared with the city, but apparently without harm, its varied experiences in insurrection, siege, and sack, and remained in the same place undisturbed until the close of 1879. Frequent references are made to it by passing travellers and visitors, such as Abd-El-Latif, Philo, Sandys, etc.

In 1714, the English traveller, Paul Lucas, found the pedestal completely buried in sand, and even the shaft up to a height of 12 feet. But this sand had evidently blown away in part in 1738, when Shaw states, "the Height of it is found to be fifty (French) Foot, three whereof are buried underground." Again, in 1743, Capt. Norden observed: "This Obelisk of Cleopatra is situated

1 Shaw, idem, 412.
almost in the middle, between the New City and the Little Phar-llon. Its pedestal, of which a part is buried, is elevated 20 feet above the level of the sea. Between this monument and the Fort runs a thick wall, flanked with a great Tower on either side of the Obelisk; but this wall is in such a ruined state, that its top is almost level with the pedestal of the Obelisk. The inner part of the wall is but ten feet from this monument, and its outer part but four to five steps from the sea.  

In 1787, the pedestal seems to have been visible, according to Savary: "Towards the eastern part of the palace are the two obelisks, vulgarly called Cleopatra's needles, of Thebaian stone, and containing numerous hieroglyphics; one is thrown down, broken, and covered with sand; the other still rests on its pedestal."  

In 1801, it was remarked by Mayer: "The Obelisk near Alexandria, called Cleopatra's needle, is a block of granite, not quite six feet in diameter at its base, and near seventy feet high originally; but its pedestal, and part of its base, are buried in the sand."  

Again, in 1843, Cooley represented the base of the Obelisk free from sand, but its pedestal still buried, standing in a pit from which the sand had been dug out, for examination by the visitor.  

On old maps, the position of the two monuments is commonly marked by two little squares, whose sides on Pococke's "Plan of Alexandria" face about N.W., but, on most maps, are placed parallel to the shore, which here runs about E.N.E., i.e., they front about N.N.W.  

In the more elaborate and faithful drawings of the many represented in plates, in early works of travel, I have made a careful examination of the hieroglyphs, and of the cartouches, whose position and number differ greatly on the different sides of the shaft; also in many photographs, taken at Alexandria at various periods, which show clearly the inscriptions and the well-marked nick, which, as already explained, was probably directed nearly to N.N.W., as the Obelisk stood at An.  

[Here the following drawings and photographs were exhibited by lantern projection: View of Alexandria from the sea, in 1755, showing the erect obelisk and remnant of the wall: Views of the Obelisk in 1755, showing the present E.S.E. side, then facing the

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1 Norden, idem, I, 5.  
2 Mayer, op. cit., 29.  
3 Cooley, op. cit., 155.  
4 Savary, idem, I, 36.  

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N.N.W.: Views of Obelisk in 1801, with truncated apex on pyramidion, in 1830, and in 1842, with the sand dug away from pedestal. Photographs in 1870 and about 1880, showing the "nick" directed landward. Views of the fallen obelisk in 1755, and the present London Obelisk, with fractured edges and pyramidion.

All these plainly and certainly show that, in the position of the shaft at Alexandria, this nick was directed toward the S.S.W.

In other words, when the Romans re-erected the shaft at Alexandria, they placed it before the new Temple of the Caesars, fronting the sea and the water-gate, i.e., toward the N.N.W.; and moreover, turned the shaft about half round from its original orientation, so that its two best preserved sides would meet the view of the visitor, on his approach to the Temple from the north. The two burned and mutilated sides were turned to the S.E. (toward the Temple) and to the E.N.E. The same position, and probably a similar rotation, were carried out in the re-erection of the companion monolith, now at London.

The view above expressed, however, does not agree with that of Goringe. In Plate XI of his work, evidently prepared in very careful detail, he gives a plan of the pedestal and steps of the foundation, as they stood at Alexandria, with the angles marked N., S., E., and W., each with an arrow, as if to impress its exactness. On the opposite page (18) he also refers to the "S.E. face of the structure" and the "S.W. face." Nor does he make any reference to the change and rotation in the position of the faces of the shaft above.


We may now report some of the testimony of travellers in regard to the condition of the surface of these monoliths and their theories to account for the injury observed.

In 1738, Shaw related: "But the Alexandrian Obelisk, lying nearer the Sea, and in a moister Situation, hath suffered very much, especially upon that Side which faceth the Northward; for the Planes of these Pillars, no less than those of the Pyramids, seem to have been designed to regard the four Quarters of the World."

In 1740, a Danish gentleman in the squadron of Admiral Haddock, reported thus in Florence: "The hieroglyphs on two adjac-

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¹ Shaw, idem, 412. ² Norden, idem, I, f.
cent sides (the W. and the N.) are of great beauty; but the others
(on the E. and S.) have been much injured by wind and damp;
that is why I have represented them exactly as they occur.17

In 1743, Capt. Norden observed: “There are only two of the
faces which are well preserved; the two others are defaced, and the
hieroglyphs can hardly be seen by which they were anciently
covered. . . . The injury and effacement on two sides of a stone of
such hardness enable us to understand the great difference between
the climate of Alexandria and that of all the rest of Egypt; for it
has neither been fire nor the hand of violence which has injured
these stones. It is clearly evident that it has been only the injury
of Time which has eaten away some of the characters and has
effaced others, although incised to considerable depth.”18

In the work of Mayer in 1801, it was remarked: “The sides
facing the N.W. and S.W. are best preserved, the hieroglyphics on
the other two sides being greatly defaced, especially toward the
lower part, large scales falling from the stone, notwithstanding its
hardness.”19

Lenormant, in 1841, concluded: “The obelisk, which has re-
mained erect, has suffered greatly from the saline and corrosive
dampness of the sea, principally on the N. and W. faces which front
the Mediterranean; that which lies overturned is perhaps still more
worn than the other.”20

In 1842, Lepsius observed: “The two obelisks, of which the
one still standing is called Cleopatra’s Needle, are very much de-
stroyed on the sides which are exposed to the weather, and in part
have become totally illegible.”21

It was remarked by Long: “Only two of the faces are in a state
of good preservation; the other two, the E. and S. sides, being so
much damaged by the moist atmosphere of Alexandria, that one
can hardly see the sculptures on them. The S. side has suffered
most of all.”22

In 1864, Clark observed that these obelisks were “sadly out of
place amid the poverty and dampness of a sea-town. One of these
is fallen, and the other is wasting away in the unfriendly air.”23

In these quotations several careless references occur in naming
the sides, as those of the N.N.W. and W.S.W. (usually called the

1 Norden, idem, I, 7.
2 Mayer, idem, 29.
3 Lenormant, idem, 47.
4 Lepsius, Letters from Egypt, 42.
5 Long, idem, 302.
6 Clark, idem, 51.
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N. and W., or the N.W. and S.W.) were the ones in good preservation, and those of the E.N.E. and S.S.E. (usually called the E. and S.) were the ones badly decayed.

As to the fallen (London) obelisk, whose base or pedestal probably still lies a few yards S.W. of the former site of the New York Obelisk, two of its sides, ordinarily designated as fronting N. and W. at Alexandria, exhibit very good hieroglyphs, but its heel and edges are battered.

Cooper also states: "The apex is roughly cut and damaged, having been covered, like most of the obelisks of Thothmes III, with a bronze cap. . . . The base of the monument and its two steps or graduæ remain entire; they are of limestone and are nearly seven feet high. . . . Owing to the position in which it fell, the monolith has been much exposed to injury, alike from the friction of the sand and the corrosive action of the salts in the sea-breezes; indeed, the S. side has suffered most of all, the hieroglyphics being in many places wholly illegible; the E. face has also suffered severely; the W. face and that which rests upon the ground have been better preserved." The following statement in regard to the surface of the under side of this obelisk, in 1801, after five centuries' partial burial in the sand, implies that the influence of this material, even so near the seashore, has been for protection rather than corrosion: "The Needle was likewise turned over, and the hieroglyphics, on the side it had so long lain on, found fresh and entire."

It will be readily seen, on reviewing these opinions, that there is no agreement as to which were the faces of our Obelisk on which the hieroglyphs were damaged. So unquestionable were the two facts, the mysterious but serious effacement of hieroglyphs on two sides and the great difference of climate in the new home of the Obelisk, that the passing traveller was often unable to accept the evidence of his own eyes. However, it is equally beyond question that it was the present E.S.E. and N.N.E. sides of our Obelisk and the corresponding sides of its London fellow which bore the brunt of attack by the sea-winds at Alexandria for nineteen centuries, and that these are in excellent condition. The injury to the other two sides must then have preceded the Roman transfer of the monoliths from An.

1 Goring, idem, 97, 108.  2 Cooper, idem, 125.  3 Bombay Courier, June 9, 1802.
11. Climate of Alexandria.

As the unanimous conclusion of the authors just quoted was to attribute the decayed condition of the surface of the obelisks to the damp and saline atmosphere of Alexandria, it is pertinent to consider here some notes on the climate of that city, in comparison with that of Upper Egypt. M. Gratien-Le-Père, Chief-Engineer of the Corps Royal des Ponts et Chaussées, in the French Expedition to Egypt in 1801, states: "The climate of Alexandria is quite healthy; although very warm in summer, this is tempered by the coolness of the nights. The dews of evening, especially in the season of the Etesian winds, are here, as in the entire maritime border of Egypt, of a saline dampness which penetrates all bodies. Winter is very rainy at Alexandria."

Viscount Valentia, in 1802, observed: "The climate is by no means unpleasant, as the heat is tempered in summer by the strong gales, which almost constantly blow from the north, and carry with them the thick black clouds, that, after breaking on the mountains of the interior of Africa, return in the floods of the Nile to fertilize the plains of Egypt."

In Southern Egypt, during the summer (April to October), the temperature varies during the day from 100° to 112° F. in the shade; in Northern Egypt it is cooler. The minimum rarely falls below 40° F. In the French Expedition, the observers noted a minimum of 36½° F., in January, 1799; the average during the night was 46° F. In 1874, a minimum temperature of 23° F. was observed by Rohlf in the Libyan desert. In the Upper Nile valley, showers ordinarily fall only on about 5 or 6 days in the year; heavy rains are rare, occurring about once in 15 or 20 years. It is commonly stated that frost and snow are wholly unknown in Egypt; yet it is recorded that frost has been seen at Cairo, and in the Algerian desert, in latitude but a few degrees further north, snow fell in the year 1847.

At Alexandria, "rain is as common in winter as it is in the south of Europe. But during the rest of the year, as little falls as in the upper country; and at 50 or 60 miles from the coast, the winter rains cease, the climate of Cairo being no less dry than that of the Thebaid.""
"The general height of the thermometer in the depth of winter in Lower Egypt, in the afternoon and in the shade, is from 50° to 60°; in the hottest season, it is from 90° to 100°, and about 10° higher in the southern parts of Upper Egypt."

"On the coast of the Mediterranean rain is frequent, but, in other parts of Egypt, very unusual. At Cairo, there is generally one heavy storm in the winter, and a shower or two besides. . . . At Thebes, a storm occurs but once in about four years, and light rain almost as rarely. The wind most frequently blows from the N.W., N., or N.E., but particularly from the first direction. . . . The southerly winds are often very violent, and, in the spring and summer, especially in April and May, hot sand-winds sometimes blow from the south, greatly raising the temperature."

A recent traveller\(^1\) states concerning the rainfall between February 1 and April 15, 1889: "My first experience in Egypt was calculated to give the impression that it is a rainy country, for I saw two showers in three days. In passing through the Suez Canal (January 31st), a heavy shower, lasting half an hour, drove the passengers to shelter, and a brilliant rainbow delighted beholders. Two days later, rain again fell at night in Cairo, making the dirty streets more nasty still. Of course this experience was exceptional, as rain is a rarity in Cairo. Authorities give the rainfall at Alexandria as about 8 inches per annum, and at Cairo about 1.2 inches; while in Upper Egypt the precipitation of moisture is far less; there are adults living there who say they have never seen rain.

I noticed, on the other hand, unmistakable signs of recent rains, such as dried mud-puddles, raindrop-prints, etc., at several points near Cairo, east of Thebes (Wadi Bab-el-Molook), and in the peninsula of Sinai, and I was impressed with the belief that more rain falls in Egypt than is usually supposed. A local shower, passing over a sandy gravelly region, makes but little impress on it; and there is no corps of trained observers, outside of Cairo and Alexandria, to record the phenomenon. . . . On February 16th I visited a wild valley west of Thebes, known as Wadi Bab-el-Molook. . . . The valley throughout shows that water has at some time been energetically at work; the floor resembles a dried-up mountain

\(^1\) Lane, Modern Egyptians, Intro.
\(^2\) R. S. Poole, Enycr. Brit., VII, 703.
\(^3\) Bolton, loc. cit., 113, 117, 118.
130 Study of the New York Obelisk as a Decayed Boulder.

torrent; banks of gravel, sand, and boulders rise several feet above the bridle-path on each side; and, at the lowest part, small channels wind about the large rocks. The hillsides are furrowed by ravines excavated by water. Here and there, in low places, usually at the foot of a large boulder, are unmistakable signs of recently formed mud. The scales and mud-cracks were quite fresh, and seemed to indicate that water had accumulated in pools not more than two or three weeks before. On my return to Luxor, I was informed that rain had fallen about three weeks before (February 16th)."

In a discussion of the heavy dews in Egypt, Volney states: "These dews as well as the rains are more copious towards the sea, and less considerable in proportion to their distance from it; but differ from them by being more abundant in summer than in winter. At Alexandria, after sunset in the month of April, clothes exposed to the air and the terraces are soaked with them, as if it had rained."

All these facts, therefore, bear out the idea of the moist character of the climate at Alexandria.


The details of the great enterprise of the lowering of the huge monolith at Alexandria, in 1879, and of its conveyance to New York, have been fully set forth by the engineer in charge, the late Commander H. H. Gorringe. It will be sufficient here to refer only to certain points which might be considered to have some bearing on possible strain or injury to the monument in transit. On October 29, 1879, the work of excavation began, and the bottom of the lowest step of the foundation was found to lie nearly at mean sea-level. This indicated a probable subsidence of the coast of about 17 feet in 1900 years, attended with a decided and increasing inclination of the top of the shaft toward the sea, which must have soon resulted in its fall.

The sides of the lower part of the shaft (as illustrated by a photograph of the bottom of the W.S.W. side, taken at the time of the removal of the London Obelisk) showed the same effaced hieroglyphs, rounded corners, and peculiar smoothed surface as now seen.

Gorringe states that in turning the Obelisk, its bottom bound against the top of one of the crabs, and "removing the crabs was

1 Volney, idem, I, 56.
very difficult, by the lead which had been poured into the mortices in the pedestal while molten.” From this it may be inferred that he found the crabs attached only to the pedestal.

In December, 1879, while the shaft, carefully sheathed in heavy plank, was being turned on enormous trunnions, supported on steel towers, a little accident occurred, which he has thus described: “Immediately following a creak louder than any previous one, the motion was suddenly arrested; then there was a sharp snap—one of the tackles had parted. Instantly the order was given to slack the other tackle rapidly, using it merely to retard the motion and not to arrest it; but the man attending the fall had lost his wits, and, instead of slackening, he held it fast and it very soon broke. The obelisk was at that moment about half over. It moved slowly at first, and then more and more rapidly, until it struck the stack of timbers, rebounded twice, and came to rest in the position” shown in an illustration. “There was intense excitement; many of the Arabs and Greeks about the grounds had fled precipitously, when the obelisk began to move rapidly; and when it rested on the stack of timber uninjured, there arose a prolonged cheer. . . . The two upper tiers of plank were crushed; aside from this, no loss or injury to any person or anything resulted from the successful accomplishment of the first essential feature of the work of removal.”

Later, during the launching of the caisson which enclosed the Obelisk, its safety was endangered in the surf by a rising storm, and Gorrinage allowed the caisson to fill, in order to diminish its buoyancy and prevent it from thumping heavily on its ways. The shaft thus remained immersed in salt water for several days.

After the monolith had reached the floating dock, and had been at last safely introduced into the hull of the Steamer “Dessouf,” Gorrinage states, “to obviate all risk of breaking the Obelisk by the working of the ship, it was placed on a bed of Adriatic white pine, very spongy and soft, and ten feet of the extremities left without support. To prevent it from moving laterally, a system of horizontal, diagonal, and vertical shores were fitted into the hieroglyphs, and driven against stringer-pieces of the steamer's hull.” During the voyage of 37 days, some stormy weather was encountered, both in the Mediterranean and the Atlantic. In spite of all

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1 Gorrinage, idem, 14.
2 Gorrinage, idem, 15.
3 Gorrinage, idem, 27.
care, it looks probable that certain projecting hieroglyphs may have been subjected to some undesirable degree of strain.

IV. NEW YORK.

On its arrival at New York, the pedestal was directly landed upon New York Island, but the shaft was first landed on Staten Island, September, 1880, then towed to the foot of West 96th Street, again landed, and thence dragged around Central Park and re-erected on "Graywacke Knoll," January 22, 1881.


The foundation of the monolith was laid upon the outcrop of the vein of endogenous granite, already mentioned. Gorringe states: "The earth having been removed from the top of the Knoll, the surface of the granite was levelled and the cavities filled with cement. A thin layer of this was then laid over the granite, and the foundation was replaced exactly as it had stood in Alexandria, each piece in the same relative position to the others and to the points of the compass."

In Plate XI of the same work, as already explained, he designates these points of the compass, for the angles, as N., E., S., and W. Elsewhere, he refers to the four sides of the shaft, as facing N., S., E., and W., taking those terms from Chabas and Brugsch, who used them, it may be presumed, loosely, in a general way.

On examination with a compass, however, I was surprised to find that the sides do not now face N. 45° E. (N.E.), S. 45° E. (S.E.), etc., but respectively N. 27° E. (nearly N.N.E.), S. 68° E. (nearly E.S.E.), etc.

Gorringe's statement refers only to the foundation of the Obelisk, but a reader would naturally infer that the shaft was also replaced here "exactly as it had stood in Alexandria." However, I must call your attention again to the tell-tale nick, now directed to about N. 18° W., while at Alexandria it pointed to about S. 28° W. It thus appears that, on its re-erection in New York, not only was the whole foundation changed in position from that which it occupied on its Alexandrian site, but that also the shaft was twisted nearly half round to the right: so that both shaft and pedestal now stand once

1 Gorringe, idem, 32.
more in the original position at An. The incorrect statement of Gorringe as to the Alexandrian position of the foundation, and his silence on the readjustment of the shaft, remain without explanation. But in his fortunate accuracy in that readjustment, I can only conjecture that he may possibly have been guided by a knowledge of the true orientation of a surviving companion of our Obelisk, the one still on the site of An: if it shall be found, by more close observation than that recorded by Niebuhr, that this really faces to the present direction of the W.N.W side of the New York Obelisk, W. 27° N.

I have plotted, on the accompanying illustration (Fig. 1), the positions which our roving monolith has successively occupied on its three sites, always accompanied, until now, by its London fellow on its left: viz., its positions at An and at New York, by the square with dotted line and nick; its position at Alexandria, by the square with broken line and nick; and, for comparison, its position at Alexandria, according to Gorringe, by the square with continuous line. The interspaces, between the two obelisks and between them and the shore, are contracted in the illustration, for convenience.

It is much to be regretted that a satisfactory explanation of the statement in question has probably been lost by the death of the eminent engineer, in July, 1881, only five months after the completion of his great enterprise, in the successful transfer and re-erection of the Obelisk.
14. The sudden decay of the surface of the Obelisk.

In regard to the condition of the surface of the New York Obelisk, immediately after its arrival, there is the following testimony by an experienced geologist,¹ in February, 1883: "The first thing that strikes one is the freshness and soundness of the rock. No 'maladie du granit' is observable, and this fact will answer the first and natural question as to why this rock was so much preferred by the Egyptians for monumental purposes."

On thin sections from the same specimen, Prof. Alfred Stelzner² also states, though with some confusion of the products of metamorphism with those of decay: "The microcline . . . is very fresh and free from interpositions. . . . Secondary formations are almost entirely wanting in the sections before me; in only two places appear viridite and yellowish green translucent needles of pistazite. The rock of the 'Needle' can therefore be regarded as unusually fresh and 'healthy,' in spite of the honorable age which it possesses."

The specimen, on which these examinations were made, probably formed part of the material cut off, in 1880, from portions of the base of the shaft, by direction of Commander Gorringe, in order to increase its bearing surface on the pedestal and stability, and to facilitate the attachment of the new bronze crabs. About four barrels full of pieces were at that time removed, and are now preserved in the American Museum of Natural History.

Within about a couple of years afterward, the incipient decay of the surface seems to have been first indicated by small pieces of granite, lying around the base, evidently fallen from above. This sudden and strange disintegration was met at first with great incredulity, since it was plainly not due to old age; the monolith had yet seven centuries to catch up with the age of its sturdy old companion, still on the site of An.

In October, 1883, this change was brought to the attention of Dr. F. A. P. Barnard,³ who found "the surface of the stone step, immediately below the plinth, sparsely strewn with minute fragments of the rock," carefully swept them off, collected and weighed them, to the amount of 24.56 grams (about ½ of an ounce). From this he calculated the waste per square meter of the surface of the

¹ Frazer, loc. cit., 364; Gorringe, op. cit., 151.
² Frazer, loc. cit., 372-374; Gorringe, op. cit., 166-167.
monument per annum to be 0.457 gram, or, from the entire wasting surface, 10.88 grams; and estimated that if "the mass of fragments actually collected was not more than a tenth part of what had fallen during the time the Obelisk has been in our Park, it would still require 6000 years to reduce its volume to the depth of one centimeter on each side."

During the next year, 1884, the progress of the decay became still more manifest by the flaking away and fall of fragments, sometimes of considerable size. Commander Gorringe could hardly believe that they came from the monolith, and expressed the hope that some day it would be polished.

In the autumn of the same year, the attention of the Park Commissioners was directed to this serious decay, and they finally decided to make use of a waterproofing process, founded on the application of melted paraffin to the artificially warmed surface of the stone. This was begun on September 25, 1885, after the Obelisk had stood, entirely unprotected from the elements, for 4 years and 8 months after its re-erection.

In the notes of another observer,1 made at this time, on the weathered exterior of the Obelisk, it is stated: "Most of the fractures of the flakes seemed of recent origin, although under most of them was found a green vegetable growth of unicellular plants. However, beneath some pieces, the accumulated black dirt showed the fractures to be of more remote origin. . . . Placing a fragment of the rock under the microscope, portions of it show decided disintegration, parts of the hornblende being broken down and dissolved, while some of the white feldspar is broken into such minute fragments that they exhibit the Brownian movement when placed in water. In the minute crevices can be seen the green cells of vegetable growth, and, on either side of the crevice, may sometimes be seen, with the microscope, the rosy hue indicating internal strains in the very minute fragments, a slight increase of which would complete the fracture; and it is possible that the growing cells may furnish the necessary strain." All these vegetable cells were green, some rod-shaped, others round like those of Protococcus plurialis.

On the S.S.W. side of the shaft, where the decay was most pronounced, some of the adhering flakes of rock were found to be parted above from the shaft as much as one-quarter of an inch, a crevice of that width being sometimes found filled with moss and black earth.

1 Dudley, loc. cit., 67.
In regard to the Protococcus, I may reply that its superficial adherence to stone-work is of common occurrence in this country as abroad; and, though often considered unsightly, its presence has never been connected with the decay of stone. The naturalist familiar with its delicate isolated cells will need proof of their ability to produce internal strains in the crevices where they find refuge.

In the preliminary cleaning of the surface, before the waterproofing process was begun, it was discovered that very many spots were in a deplorably decayed condition, especially on the S.S.W. and W.N.W. sides of the shaft. Some large pieces were so loosely attached that they would scarcely bear the hand upon them without falling away. One large slab on the E.S.E. face, with the hieroglyphic symbol of the sun in its centre, actually dropped off in the grasp of a person who laid his hand upon it, to steady himself, while walking by upon the scaffold. This piece was left below, stolen over night and never recovered. No attempt was made to harden or recement this crumbling surface, but it was decided to remove only the looser flakes, most likely to fall, and then apply the preservative. In the course of this removal, one fragment, showing hieroglyphs, was separated from the upper part of the W.S.W. corner of the shaft, which measured 18 2/3 inches in length, 3 1/2 inches in width, and 2 1/2 of an inch in thickness; but most of the scales were small pieces, often cracked and ready to crumble. In all, about 2 1/2 barrels of pieces were removed, found by the Park Superintendent to weigh 780 pounds; of these, three-quarters or more came from the S.S.W. and W.N.W. faces of the shaft. In regard to the great error of judgment shown in the above action, I have elsewhere expressed the universal public opinion.

15. The waterproofing treatment of the Obelisk.

The entire surface of the Obelisk was then warmed, in successive portions, by the application of a square pan of burning charcoal, with front of wire grating, for two or three minutes, at a distance of about one inch. The projections and hollows on the surface were warmed by means of a benzine blast-lamp. Immediately after the warming, the compound of paraffin, containing creasote

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1 Misfortunes of an Obelisk, loc. cit., 132.
2 Robert M. Caffall, Scientific American, XXI (1886), Supplement, p. 891; and in paper on "The Preservation of Building Materials by the Application of Paraffin, as recently used upon the Obelisk," Trans. N. Y. Acad. Sci., V (1885), 56-66.
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dissolved in turpentine, was applied at its melting-point (146° F.)
by means of a brush, and the stone then warmed again until the
excess of paraffin was absorbed beneath the surface. The surface
treated, on shaft and plinth, amounted to about 220 square yards,
and absorbed 67 3/8 pounds of paraffin, to an estimated depth of half
an inch or a little more. An equal surface of brownstone would
have taken from 40 to 50 pounds, and of brick from 50 to 110
pounds; so that the great porosity of the weathered coating of the
Obelisk is clearly shown. Little difference in the action of different
parts of the surface toward the paraffin was noticed, except that the
black masses of hornblende were particularly absorbent.

A few months afterwards, Dr. T. Egleston presented views founded
on an inspection of the Obelisk and of pieces derived from its decayed
surface. In these he observed, under the microscope, deep irregular
cavities, near the grains of hornblende, empty or partly occupied by
that mineral, and crevices containing the green Protococcus referred
to by Mr. Dudley. He concluded that disintegration had been long
going on and was still in progress in the interior of the stone, not
of chemical but purely physical cause, mainly the repeated expan-
sion and contraction produced by the rapid and extreme changes of
temperature in this climate. In regard to the waterproofing process
applied to the Obelisk, he states: 1 "The method of applying the
present protecting coating seems to have been a fatal mistake.
Nothing of any account has been dissolved out of the stone; there
is therefore nothing to be replaced. If there had been, paraffin in
solution would have been one of the best materials to fill them.
Granite is not porous; there were, therefore, no cavities to be filled.
The stone being full of cracks from natural causes, the heat which
was used to cause the paraffin to sink into the body of the stone,
when applied to the outside, would cause an expansion, which would
not be responded to by the interior of the granite, and the cracks
already there would increase in size, and pieces would chip off as
they did, and new cracks would be formed in the stone, already
weakened by long exposure. . . . Even if the surface was entirely
waterproofed, the cold of winter and the heat of summer would act
below the surface both of the coating and of the stone, causing the
coating to break or fissures through it to occur, so as to let in the
moisture, and then both causes would operate together as before."

1 Egleston, loc. cit., 81.

Annals N. Y. Acad. Sci., VIII, July, 1893.—19
The crumbling decayed stone from the surface of the Obelisk was very unsatisfactory material from which to determine the condition of the stone beneath, and misled the three observers to quite opposite conclusions concerning the decay: Dr. Barnard, to disbelieve in its extent and progress: Mr. Dudley, to connect it with strains produced by the cells of Protococcus: and Dr. Egleston, to attribute it mainly to temperature-variations in our own climate. However, the slight plant-growth was doubtless merely accessory. It will be shown beyond that granite is really porous, and its cavities occupied by a substance, moisture, which must be displaced for the proper introduction of any preservative: that this is too powerful a stone to be injured by gentle warming: and that oscillations of temperature had nothing to do with the sudden disintegration of the surface of the Obelisk in 1882–1885.

In regard to this mooted and important question—the effect of moderate elevations of temperature on granite, I have next to present, first, the results of a series of experiments on the application of artificial heat to various building-stones and to the granite of Syene: secondly, some comparative statistics, reduced and tabulated, from meteorological reports on thermometric oscillations in Egypt and New York.


In view of objections taken against the application of heat to granite, as used in the process of waterproofing the Obelisk in 1885, I have made sundry experiments to determine the degree of heat then used and the exact periods of time during which it was applied, repeating exactly the same process with the same apparatus and workmen.

On testing with a thermometer the melted paraffin compound in the "U. S. pot" used in the process, it was found, if the paraffin was allowed to become entirely fluid, that its temperature rose to 70° to 75° C. But when, as always occurred during work, a cake of solid paraffin was kept floating in the liquid, the temperature varied from 59° to 67° C., closely approximating 63° C. (146° F.).

During the autumn of 1889, the ordinary waterproofing of stone buildings near New York City was carefully studied. On a cold day, at Orange, N. J., I carefully watched the application of the process to surfaces of Nova Scotia sandstone, in a state of incipient decay, to ascertain the periods during which the stone surfaces
were heated, the melted paraffin applied, and the stone reheated. A condensed statement of the observations is here presented.

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Surface treated</th>
<th>No. of observations</th>
<th>Periods (in seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>First heating</td>
</tr>
<tr>
<td>1</td>
<td>Stone chimney</td>
<td>3</td>
<td>29</td>
</tr>
<tr>
<td>2</td>
<td>Decayed brick wall</td>
<td>5</td>
<td>78</td>
</tr>
<tr>
<td>3</td>
<td>Stone jams and mullions of a window</td>
<td>3</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>The same</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td>5</td>
<td>The same</td>
<td>4</td>
<td>28</td>
</tr>
<tr>
<td>6</td>
<td>Brick wall</td>
<td>7</td>
<td>28</td>
</tr>
</tbody>
</table>

The temperature of the air was 60° C. (43° F.), which happens to be about that which prevailed during the waterproofing treatment of the Obelisk in 1885. In the treatment of Nos. 1, 2, and 6, the charcoal-stove was applied, at a distance of 1 to 3 inches from the surface; in that of Nos. 3, 4, and 5, the benzine blast-lamp, over a surface of about 40 square inches. During the heating, a few sandy particles fell from the decayed and softened surface. From the totals, it appears that the entire treatment of a stone-surface, as observed with several workmen, was completed, on the average, in 58 seconds.

These results served as a basis for arrangement of a series of experiments, carried on some weeks later, with the same process and apparatus, in the north court of the old building of Columbia College, at 50th Street, New York City. The treatment was applied in the usual way to various surfaces of old brickwork, covered with hard and dry cement-stucco. In each experiment a thermometer was so inserted, beneath the stucco, that its bulb lay at the depth of 3 mm. (1⁄8 inch) below the heated surface; the object was to determine the rise in temperature of the superficial layer of cement. Temperature of the air, 15°.5 C.

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Source of heat</th>
<th>Original temperature of cement</th>
<th>First heating</th>
<th>Paraffining</th>
<th>Reheating</th>
<th>Total period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Period (in seconds)</td>
<td>Resulting temperature</td>
<td>Period</td>
<td>Temperature</td>
</tr>
<tr>
<td>7</td>
<td>Blast-lamp</td>
<td>12°</td>
<td>85</td>
<td>35</td>
<td>25</td>
<td>145</td>
</tr>
<tr>
<td>8</td>
<td>Blast-lamp</td>
<td>13°.5</td>
<td>55</td>
<td>24° to 24° C</td>
<td>35</td>
<td>25</td>
</tr>
<tr>
<td>9</td>
<td>Stove</td>
<td></td>
<td>135</td>
<td>35</td>
<td>35</td>
<td>205</td>
</tr>
<tr>
<td>10</td>
<td>Stove</td>
<td>17°.5</td>
<td>50</td>
<td>34°</td>
<td>20</td>
<td>100</td>
</tr>
</tbody>
</table>
It was apparent that the temperatures recorded by the thermometer only indicated the inferior conduction of heat by the layer of cement. Other tests satisfied me that, with a layer of compact stone like granite, the final temperature in each experiment would have risen at least 20° higher than those above observed.

In order to determine the surface-temperature attained during the heating, the treatment was then applied to a series of dressed cubes of various building-stones, one inch square, imbedded in square cavities, one inch deep, cut in the surface of the cement, so that the outer faces of the cubes in each group lay in the same plane with the surface of the cement. At the end of the second heating, the bulb of a thermometer was instantly applied to the surface of the cubes and covered with felt to prevent radiation.

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Source of heat</th>
<th>First heating period</th>
<th>Paraffining period</th>
<th>Second heating period</th>
<th>Total period (in seconds)</th>
<th>Final temperature</th>
<th>Kind of stone</th>
</tr>
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<tr>
<td>11</td>
<td>Stove</td>
<td>85</td>
<td>35</td>
<td>15</td>
<td>135</td>
<td>42°.1 C.</td>
<td>Dark sandstones</td>
</tr>
<tr>
<td>12</td>
<td>Stove</td>
<td>95</td>
<td>27</td>
<td>30</td>
<td>152</td>
<td>64°.7</td>
<td>Granites and marbles</td>
</tr>
<tr>
<td>13</td>
<td>Stove</td>
<td>112</td>
<td>35</td>
<td>0</td>
<td>150</td>
<td>51°.6</td>
<td>Limestones</td>
</tr>
<tr>
<td>14</td>
<td>Stove</td>
<td>94</td>
<td>22</td>
<td>24</td>
<td>140</td>
<td>62°.7</td>
<td>Light-colored sandstones</td>
</tr>
<tr>
<td>15</td>
<td>Blast-lamp</td>
<td>49</td>
<td>16</td>
<td>19</td>
<td>84</td>
<td>67°.3</td>
<td>Granites</td>
</tr>
<tr>
<td>16</td>
<td>Blast-lamp</td>
<td>73</td>
<td>31</td>
<td>13</td>
<td>117</td>
<td>70°.1</td>
<td>Granites</td>
</tr>
<tr>
<td>17</td>
<td>Blast-lamp</td>
<td>68</td>
<td>34</td>
<td>16</td>
<td>118</td>
<td>69°.8</td>
<td>Granites</td>
</tr>
</tbody>
</table>

To the final temperatures found, I saw reason to attach no importance, as they were evidently much diminished by the rapid radiation, before adjustment of thermometer and felt. So both stove and blast-lamp were then each applied directly to the bulb of a thermometer, at a distance of one inch, shifting the source of heat about in the usual way. It was thus found, on repeated trials, that a temperature approaching 80° to 85° C. (185° F.) was momentarily attained.

From these results we may gather the following as probable conclusions, in regard to the conditions of temperature during the waterproofing treatment of the Obelisk in 1885:—

(a). The period of heating by stove or blast-lamp and by the melted paraffin was probably a little longer than in the regular process, i.e., 2 to 3 minutes (instead of 1).

(b). The temperature of the melted paraffin, as applied, did not exceed 67° C. (158° F.), and in general was about 68° C. (160° F.).
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(c). The surface of the stone was rarely subjected to a higher temperature than 85° C. (185° F.), and probably never, when the stove was used.

(d). Only a very thin outer layer of the granite of the Obelisk was heated beyond the melting-point of paraffin, 60–63° C. (146° F.), probably between 6 and 12 mm. (¼ to ½ inch) in thickness.

Some effort was also made, in these experiments, to ascertain whether the surface of the granite of the Obelisk could have suffered damage from the temperatures (60° to 85° C.) and treatment indicated. Among the samples of granite imbedded in the surface of the cement were pieces of the original fresh stone of the Obelisk, each with a polished face set in flush with the general surface. These faces had been previously studied under pocket-lens, and then under a microscope, with magnifying power of 30 diameters. On re-examination, after the conclusion of the treatment, no effect whatever was detected on the surface subjected to the stove; on the other, treated by the blast-lamp, two or three very minute checks or crevices, perhaps a millimeter in depth, seemed to have developed.

On the same question, some information may be derived from the experience of lithologists, in the mode of mounting thin rock-sections for microscopic examination. After having been ground down to transparent pellicles of extreme thinness and delicacy, these are commonly immersed, on a slide, in a drop of partially inspissated and hardened Canada balsam.

In the first experiments on this subject, a drop of balsam on a glass slide was heated upon a mounting-table, usually from 3 to 5 minutes, for the partial evaporation of the excess of turpentine, its natural solvent. At this point, in place of a rock-section, the bulb of a delicate thermometer was inserted into the drop, and a temperature of 107° C. (220° F.) was noted.

Again, a quantity of the balsam, about 200 c.c., was slowly evaporated in a shallow tin-pan, over a low flame. The temperature, 50° C. during the first half hour, then rose to 108–110° C., and so remained for 3 hours; after 7 hours, when the medium had attained the proper viscosity, the temperature fell to 80°, and, while cooling and still viscid, to 60°.

Since, therefore, the scrupulous needs of the lithologist, in the investigation of intricate structures of rocks and minerals, are not endangered by subjecting a thin rock-section to a temperature of even 107° C. for a minute or more; there seems to be no reason to
presume that any injury could have been done to the surface of the Obelisk, in the waterproofing process, by warming at a temperature which rarely approached 85° C., during a period not exceeding 2 or 3 minutes.

17. Effects of the sun's heat on granite.

In regard to the action upon granite of high natural temperatures, it should be noted that those of rock surfaces, exposed to the sun during the heats of summer, often rise to 150° F. (66° C.) and over, especially if the rock is dark-colored; and that of the sands of African deserts sometimes reaches 200° F.

An interesting application of this natural warming of surfaces of stone occurred during the hottest period of August, this last summer (1892), at Sandy Hook, N. J. The casemates of the fortifications are constructed of a dark concrete, in large part composed of fragments of "bluestone" (flagstone from the base of the Catskill Mountains). On account of the porosity of the concrete and its permeability by rain-water, these constructions had been undergoing for some months the same waterproofing treatment with paraffin as that applied to our Obelisk in 1885. On certain hot afternoons, it was found that the surfaces of those bomb-proofs which lay exposed to the sun had already become heated to such a degree that artificial heating could be dispensed with and the melted paraffin directly applied.

It is a question of some interest, in reference to the durability of building-stones used in New York City, to determine how often the direct heat of the sun reaches its maximum in this climate. By a collation of the observations of Mr. Daniel Draper,¹ the Director of the Meteorological Observvatory in Central Park, the following table has been prepared, presenting for ten years the maxima in the sun of 140° F. or over and of 146° F. or over. The latter temperature (63° C.) is that of the melting-point of the particular paraffin referred to above.

¹ Abstract of Registers, 1880 to 1889.
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<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1880</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>25</td>
<td></td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>1881</td>
<td>2</td>
<td>6</td>
<td>15</td>
<td>9</td>
<td>1</td>
<td>33</td>
<td></td>
<td>5</td>
<td>2</td>
<td>5</td>
<td>12</td>
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</table>

Total number of days for ten years 103 32

The extreme maxima reached were 151° F., on September 6, 1880, and 154° F., on September 7, 1881. The hours at which the temperature in the sun reached its maximum are recorded for each day in 1885, 1886, and 1887; from these we may conclude that the maximum continues on an average for about 1½ hours, or perhaps somewhat less. If we assumed that the light colored surface of the granite of the Obelisk reached on these days the same temperature as that indicated by the bulb of the maximum thermometer in the sun, which is not probable, we might infer that the surface of the monolith is occasionally heated to the temperature of 116° to 150° F. for short periods, which amount, on an average, to less than five hours during the whole year.

There is then no foundation for the fear, expressed by some persons, that the paraffin, at that melting-point, may flow or has already flown down from the surface to the base of the monument, under the attack of our summer sun. It is more probable, so far as the heat of the sun may ever cause the surface of the paraffin to melt, that this will recement and solidify, during each summer, the superficial minute cracks produced in the paraffin through contraction by the cold of the preceding winter.

As to the intense heat of the Egyptian sun, there is abundant evidence. Burchhart observed the temperature of the air at Esnè at 139° F., and Coutelle, that at Cairo at 127° F., and at Philæ, 129° F.1 Coutelle records a constant temperature at Philæ, from

1 Poissas, idem, II, 272.
19 to 3 P.M., at 107°.5 to 109°.5 F., on the north and in the shade; in the sun, in open air, up to 113° F.; in the sand, 158° F. ¹ Nonet found, opposite the ruins of Thebes, that a thermometer in the sand, at noon, rose to 158°.5 F.; in the shade, 100°, with light wind from N.W.² Also at Philæ, he observed thermometer in the sand at 153°.5 F., and in the shade, 109°. During the removal of the western Luxor Obelisk to Paris, in July, 1836, the engineer in charge, M. A. Lebas, states that the sands burned his feet, the temperature of the air, on one day, remaining for four hours at 66° C. (151° F.): a sun which strongly recalled, as he feelingly remarks, "the energetic and fitting expression of Moses in regard to Egypt; this furnace of fire."³

Dr. Donald Dalrymple,⁴ in 1861, called attention to the considerable diurnal variations of temperature in the climate of Egypt. His series of observations of the temperature of the air, on a Nile boat, during the winter of 1859–1860, showed the following average ranges:

- **December, 1859**: 36° F.
- **February**: 30° F.
- **January, 1860**: 44° F.
- **March**: 36° F.

He also states that "the minimum never registered within 6 degrees of freezing-point out of doors."

More definite on this point are the meteorological observations of Dr. J. D. Hutcheson,⁵ at Thebes, during five months of the coolest season, from November, 1881, to March, 1882, inclusive. During each of these months, the daily maxima in the sun, when reduced from his tables, are found to vary as follows:

- **March**: 134°–155° F. (57°–68° C.).

These figures show that the maximum heat of the sun must be in Egypt far more intense, continuous, and severe upon stone than in the climate of New York. This surprising conclusion is exactly contrary to the prevailing opinion, frequently expressed, concerning the trying climate of New York, with its supposed extraordinary and sudden ranges in temperature. To these has been mainly attributed the mysterious and sudden destruction which began to affect the surface of our Obelisk, soon after its re-erection in New

¹ Coutelle, loc. cit., 334.
² Nonet, loc. cit., 341.
³ Lebas, idem, 60.
⁴ Dalrymple, op. cit., 7, 11, 25.
⁵ Stuart, Fun. Tent of Eg. Queen, 146.
⁶ Egleston, loc. cit.
York (January 22, 1881). As it fortunately happened that the period covered by Hutcheson's observations began in the autumn of that year, it would be interesting to compare the similar observations made by Draper at the same time in this city. As conclusions from averages are also often deceptive, it appears desirable to present the daily observations at both localities. In the following table, I have therefore reduced the daily ranges in temperature during those five months, at each place, in Fahrenheit degrees, between the maximum in the sun and the minimum in the shade.

**Daily Ranges in Temperature (F.) between Maximum in Sun and Minimum in Shade.**

<table>
<thead>
<tr>
<th></th>
<th>New York</th>
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<th>Thebes</th>
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<tr>
<td></td>
<td>1881</td>
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<td>1881</td>
</tr>
<tr>
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<td>19.07</td>
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<td>18.67</td>
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<td>19.12</td>
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<tr>
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<td>18.84</td>
<td>19.11</td>
<td>19.17</td>
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<tr>
<td>Feb.</td>
<td>18.79</td>
<td>19.08</td>
<td>19.15</td>
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<tr>
<td>Mar.</td>
<td>18.78</td>
<td>19.03</td>
<td>19.12</td>
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<td>18.91</td>
<td>19.00</td>
<td>19.04</td>
<td>19.01</td>
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</tbody>
</table>


The similar averages, at New York, for the remaining months of 1882, were as follows:—

<table>
<thead>
<tr>
<th>April</th>
<th>. . . . 49</th>
<th>July</th>
<th>. . . . 60</th>
<th>October</th>
<th>. . . . 30</th>
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<tbody>
<tr>
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<td>August</td>
<td>. . . . 59</td>
<td>November</td>
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<td>. . . . 61</td>
<td>September</td>
<td>. . . . 38</td>
<td>December</td>
<td>. . . . 50</td>
</tr>
</tbody>
</table>

These figures show that while the changes in the range of temperature at New York are frequent and sudden, and correspondingly trying from the physiological point of view, the actual daily ranges of temperature at Thebes are 60 per cent. greater than those at New York, constant, and proportionately severe in the amount of repeated expansions and contractions of the surface of stone caused by such daily oscillations. The ranges at Thebes do not lose in importance from the fact that they occur somewhat further up the scale than at New York, since the question of frost is a distinct subject for consideration.

A natural conviction as to the severity of our climate, with its intense heats of summer, bitter cold periods during midwinter, and frequent and sudden alternations of rains, snow, and sunshine, thawing and freezing, during spring and autumn, has influenced the popular judgment on the true causes of stone-decay.

The common, and, as I think I have shown, mistaken view, thereon upheld, may have been partly founded on inexact appreciation of the intervals between conspicuous extremes of temperature at New York. Thus, in January, 1882, the observed temperatures varied at one time from 97° F. in the sun to —6° F. in the shade, but with an interval of six days between these extremes, and no greater range than 58° on any one of those days. At Thebes, in the same month, the variation of 94° occurred on a single day (the 2d), viz., from 45° to 139° F.

But the actual ranges of temperature to which the surface of a solid body must have been subjected at Thebes, between the extreme heat of the burning sun by day and the cold produced by radiation toward the cloudless sky of Egypt by night, may be probably better estimated with reference to the minima recorded at night by a thermometer on the grass. From Hutcheson’s tables for these minima and for the maxima in the sun, I have deduced the following variations of the daily ranges of temperature during each of the same five months.
December . . . . . . . . 94°–109° F. (52°–61° C.).
February . . . . . . . . 72°–110° F. (39°–61° C.).
March . . . . . . . . . . 76°–117° F. (42°–65° C.).

It therefore appears that, even during the coolest season at Thebes, the surface of solid bodies must be subjected to daily variations of temperature approaching 72° to 117° F., i.e., about 100° F. every day. Also, from the table of maxima already given, that a surface of stone is daily heated for a time, during eight or nine months of the year, to a temperature at or above that of melting paraffin (146° F.). So far then as concerns mere oscillations in temperature, the climate of Egypt must be far more trying to the surface of stone than that of New York; the Obelisk, since its transfer to New York, has been in much less need of protection from injury by mere variations of heat and cold; and its sudden decay immediately after its arrival here was certainly not due to this agency.

This subject has been here considered and discussed in some detail, on account of the divergence of my conclusion from the common view, and of its practical bearing on the true cause of injury to building-stones, as well as to the Obelisk, to be feared from our climate, and on the proper method for their protection.

We have also invaluable evidence, already presented, as to the slow action of even the burning sun of Egypt, as well as of its extreme diurnal changes of temperature, upon the surface of granite, in the condition of all the obelisks and of their sides which faced the midday and afternoon sun (paragraph 8, (4), b), during recorded periods of enormous length.

18. Waterproofing treatment of other Egyptian obelisks.

We may here pertinently refer to processes adopted abroad for the protection from the weather of other Egyptian obelisks of the same granite, and to the scanty testimony concerning their results.

(1). The London Obelisk.—This monolith, once the fallen companion of our own at Alexandria, reached the Thames, January 20, 1878, and was re-erected on September 12 of the same year. As to its condition on arrival, Prof. Bartlett, of London, has stated in a letter: ‘‘Soon after it arrived in the Thames, I was requested to examine its then condition, and to advise a professional friend at
the Metropolitan Board of Works. My report was that the granite had become largely decomposed at the surface, and was more or less undermined by the action of the weather during many centuries; that one face was far more eroded by the attrition of the sand, and perhaps by the chemical action of the Nile water, than were the other three sides. In short, that the granite was precisely in that absorptive state that it would imibe dampness from our atmosphere, and become liable to exfoliate and throw off scale after scale, under the influence of frost, until but little of the inscriptions would be likely to remain, after one or two of our English winters." As to the preservative soon after applied, Mr. John Dixon, the engineer who conveyed the monolith to London, writes, in a recent letter (May, 1891) to the London Times:

"My attention has been drawn to some statements in the House of Commons as to the alleged decay of the Egyptian obelisk on the Thames Embankment.

"After making a careful personal examination of the monument, my critical eye fails to detect upon its surface a sign of any decay whatever. Were there such, there could be no doubt there would be grains of the stone lying on the altar steps and top of the pedestal. I climbed up and could not see one sign of any decay. I also could see glittering points on the surface, of the solution of silica supplied to me by the skilled chemists of the British Museum, at the suggestion of my old friends, Sir Richard Owen and Dr. Birch, and of which three coats or washes were given with the greatest care, before the trunnions and fastenings for the final lift were placed around it."

However, it has also been stated,¹ probably in reference to a subsequent treatment, that the same monolith "was treated, in 1872, by Mr. Henry Browning, with a solution of gum dammar dissolved in benzin, to which a small amount of beeswax was added, and a very small quantity of corrosive sublimate."

(2). The Paris Obelisk.—After its removal from Luxor to Paris, in 1836, this monolith lay untouched for 22 months, while its pedestal was being quarried from a granite outcrop in the western part of France. After its erection, "as a protection against a climate so much more rigorous than that of its native land, the surface of the obelisk was covered with a concentrated solution of caoutchouc."²

² Goringe, ibid., 92-93.
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It has also been stated that several attempts were made to weatherproof this obelisk with the silica treatment.

As to the present condition of this monolith, Prof. Egleston\(^1\) states: "The obelisk in the Place de la Concorde in Paris is reported cracked all over its surface. Both the European obelisks are therefore in danger of being seriously damaged within the next hundred years."

19. Examination of Obelisk by Committees of Experts.

On November 30, 1889, the Commissioners of the Public Parks of the city of New York requested the following persons to act as a Committee of Experts, to make an examination of the Obelisk and report to the Board, as soon as practicable, as to its condition, with reference particularly to its preservation, viz., Lt.-Col. G. L. Gillespie, of U. S. Engineers, Prof. J. S. Newberry, Albert H. Gallatin, and R. O. Doremus, Mr. E. E. Farnam, former U. S. Consul General in Egypt, and the author. On May 20, 1890, the Committee reported\(^2\) that they had found the general surface of the Obelisk "in as perfect a state of preservation, apparently, as when it was treated with the paraffin wax compound, over 4 years and 6 months ago," and "in no present need of any additional treatment." They recommended an additional local treatment, by the same process, of certain spots on the monument, which, before 1885, had become more deeply decayed and yet give a hollow sound to a light blow. Of these spots a full individual description was given in an Appendix to the Report, together with a chart of the four faces of the Obelisk, showing their exact location. It was further recommended that the process should be modified for this special purpose, by application of more gentle and longer continued warmth, without the use of the blast-lamp; that no stone should be removed from the surface of the monolith: that a preliminary experiment should be carried on upon a large block of coarse granite, to determine the depth of penetration of the compound into the stone: and that the retreatment of these spots on the Obelisk should take place during the hottest part of the following summer, July or August, when the stone was in its driest state. The recommendation of re-treatment of these spots simply meant that, in view of the deep decay and exfoliation which had occurred up to 1885, the process had been

\(^1\) Loc. cit., 84.
\(^2\) Report, p. 10.
then carried on too rapidly to insure, in such spots, an infiltration of melted paraffin to a sufficient depth for perfect safety.

On June 30, 1890, the Park Commissioners appointed a Second Committee, consisting of the late Prof. John S. Newberry, (Prof. Albert H. Gallatin, who was unable to serve) and the author, to carry out the proposed experiment and define the details of the modified process. On July 24, this Committee sent in their Report. This and the preceding Report (with the exception of its Appendix and chart) have been printed by the Park Department, but only in small number. It is therefore desirable to present here the principal facts, including the more scientific and technical details.

"The object of the experiment was to determine the best conditions for the re-treatment of the decayed spots upon the Obelisk during the coming month of August. . . . It was necessary in the first place to obtain a large block of granite of approximately the same mineral composition and texture as that of the Obelisk, and, if possible, of the same size." After much exploration of the granite yards of New York City to obtain the use of a block of sufficient size, and many inquiries concerning the granite quarries up the Hudson River, in Connecticut, near Saybrook and along the Sound, and in the islands off the coast of Maine, "our attention was directed to the many large transported boulders of granite or coarse granitoid gneiss which are strewn over the surface of Westchester County. In masses of rock like these, exposed to the weather for ages, we might fairly expect to find the better material for which we were looking—that which had experienced an incipient internal decomposition and increased power of absorption, as in the granite of our ancient Obelisk. Near Tuckahoe and New Rochelle several such boulders were found, though of insufficient size, on the lands of Mr. F. Wiede and of Mr. C. Morgan, to whom also our thanks are due for offered assistance.

At last, near the summit of a hill on Midland Avenue, about two and one-half miles southwest of Bronxville, an enormous boulder, nearly twenty feet in height, of granitoid gneiss, was found on the DeWitt property, which seemed well enough suited for our object. Its mineral components were found to be very nearly the same as those of the Obelisk, viz.: white feldspar (triclinic), potash feldspar, quartz, hornblende, biotite-mica, and a little garnet, magnetite, etc. The volume of the entire boulder was measured and ascertained to be nearly three times that of the Obelisk; but it was divided in two
parts by a deep cleft. Our application to Mr. William D. DeWitt for its use met with his ready consent, and whatever help we needed."

In the ensuing experiment, the Committee had two points in view:—

First, "to determine the rate of penetration of a definite amount of heat into a huge mass of granite, when applied continuously to a small spot on one surface." The practical object was to ascertain the time needed to bring the temperature of a layer of the granite, one to two inches in thickness, up to or a little above the melting-point of paraffin, without injury to the stone.

Secondly, to determine the most effective way, and proper apparatus, for the application of melted paraffin, to cause the deepest penetration and thorough saturation of the warmed stone and of any cavities or crevices lying beneath its surface.

(1). The application of heat.—The N.E. corner of the huge boulder was selected for the main experiment, where two vertical faces, approximately even and smooth, met nearly at a right angle. The N. face presented, in cross-section, the edges of the vertical laminae of the gneiss. The E. face was reserved for the application of the heat, and on the N. face, at a point about 6 feet above the ground, a series of 13 horizontal holes, about 2 cm. in diameter, were drilled at right angles to the face, each to the depth of about 10 inches, for the insertion of a set of thermometers in a sloping line. The direction of these holes was controlled by means of an instrument constructed on the principle of parallel rules; by this also the exact distance was ascertained between the bottom of the hole, where the bulb of the thermometer would lie, and a marked spot on the east face of the boulder, 10 inches south of the corner. The holes were arranged in a line sloping upward at an angle of about 45°, with the purpose that every thermometer-bulb should lie horizontally behind the warmed spot on the east face of the boulder, and yet without the interposition of any other of the bored holes and interference with heat-waves which might thence result. Into these holes the set of long delicate thermometers, with open Centigrade scale, were inserted and firmly packed with soft asbestos-wool or cotton, so that their bulbs were arranged at the following successive distances from the east face, 1.7, 2.4, 2.8, 3.1, 4, 4.8, 5.6, 6.5, 8.3, 24.6, and 50.1 centimeters: and so that the degrees above 20° C. were visible at a glance, upon the projecting parts of the scales, from an observer on a small platform near the corner on the north side.

In front of the east face a shears was erected, supporting the
source of heat, a flat charcoal stove or upright pan, 20 by 14 inches in dimensions, with its face covered by coarse wire-grating, kept filled with charcoal at red heat. This stove was suspended usually at a distance of about 25 inches from the marked spot on the east face. In order to direct and control a uniform heat upon this spot, the stove was partly surrounded by a sheet-iron screen, extending from the stove to the surface of the rock.

The degree of surface temperature was determined by another thermometer, whose bulb lay against the same marked spot. It was controlled by moving the stove occasionally back and forth, when the ignited charcoal varied a little in radiated heat, as on the addition of fresh fuel, so that the temperature should remain at about 88° C. (190° F.); it was found to be under easy control, within a few degrees, with the apparatus described. The experiment began at 11 A.M., on Tuesday, July 20, 1890, in charge of both members of the Committee, and continued for 7½ hours until sunset, the thermometers being constantly observed and noted. The day happened to be very suitable for the experiment, clear and warm, the temperature during the afternoon varying from 25° to 21° C.; the air was nearly calm, with only now and then a very light breeze, which was continuous after 5 P.M. At any time during the experiment, the observer could without discomfort lay his hand on the warmed surface of the rock, alongside of the thermometer. With constant and careful inspection of the surface, during the heating and at its close, “no evidence whatever was seen of cracking, scaling, or any other injury to the warmed stone” on the east face, or on its section on the north face.

(2). The application of melted paraffin.—To the spot on the east surface of the boulder, warmed for 4½ hours as just described, melted “paraffin, colored red by alkanet root, was applied with a brush for a few minutes, before the sun went down and brought this experiment to an end. The reddened paraffin was found to have penetrated at least 1.7 centimeters (⅛ of an inch), even with so short an application.”

“During that experiment, however, another stove was applied in the same way to a neighboring boulder of the same stone, of smaller size, during two hours. To this spot a shallow metal tank was taken quickly and tightly fitted, with its side open against the warmed rock, and filled with the same colored paraffin, kept liquid for one hour longer. The tank was then removed, and, on the next day, the face of the rock was cut off and the depth of penetration
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of the paraffin observed on the cross-section. At that part of the face of the rock which had been subjected to the melted paraffin for one hour, it was found that a layer of twenty-five to thirty-two millimeters (one to one and one-quarter inch) had been saturated."

To facilitate observation of the depth of penetration, the melted paraffin had been previously dyed to a deep red color by alkanet root. But the curious fact was observed that, although the color was apparently held in true solution, it was strained out of the paraffin by the outer layer of decayed rock, about 3 millimeters in thickness, and only uncolored paraffin penetrated below. As the latter was easily distinguished, this result was of no practical importance. I presume that it may have been due to a precipitation of the color, as a "lake," by the kaolin or free alumina in the weathered crust of the rock.

The Report concluded with the following five recommendations by the Committee:

"1. That the comparatively slow penetration of paraffin into the solid granite, after so long an application of heat, confirms the view of the shallowness of the present layer so saturated upon the surface of the Obelisk, as accomplished nearly five years ago by the usual quick process. Therefore the experiments of the present Committee lead us to renew the recommendation of local re-treatment, in order to insure the safety of the cracked and more badly decayed spots. The absence of the least indications of injury to the stone, after four hours' continuous warming, seems to us to show that the process can be used without danger. . . ."

"2. That the heat should be applied to each spot in the way and with the apparatus already described, at a distance not less than twenty-four inches, in such a way as to keep a thermometer, with its bulb applied to the warmed surface, at a temperature not exceeding one hundred and ninety degrees Fahrenheit, and for a period of about two hours.

"3. That those decayed spots whose small size (three or four inches), indistinct sound on tapping, and freedom from visible cracks, indicate the probable shallowness of the decayed or loosened flake, shall be then, while still continuously warmed by the stove, repeatedly painted over with melted paraffin, by means of a brush or sponge, for about one-half hour to one hour, until the rejection of the paraffin shows their perfect saturation.

1 Report, 14.

Annals N. Y. Acad. Sci., VIII, July, 1893.—11
4. That those decayed spots whose large area (sometimes reaching a diameter of twenty inches), deeper hollow sound, and display of cracks, indicate the depth of their decay and the possible existence beneath of a cleft or cavity of some size, shall be submitted, immediately after two hours' warming, to the action of a tank of melted paraffin for about an hour, or until there is evidence of the arrest of absorption of paraffin.

For this purpose we also recommend the use of tanks of greater height, in order to increase the hydrostatic pressure of the melted paraffin and its consequent penetration into the interstices of the rock.

5. We particularly recommend the careful treatment, in the latter method, of the large loosened flakes upon the west face of the pyramidion and vicinity, and of the southwest corner of the Obelisk for thirty feet below, and that the cracks be left neatly filled up or 'pointed' with solid paraffin."

20. **Experiment on rate of penetration of heat into granite.**

For the practical end in view in the experiment described, the rough estimate stated was entirely sufficient. But the figures obtained were available for a closer determination of the rate of penetration of the heat-wave, and this has been since calculated and is now presented below.

Before the experiment, the entire set of thermometers, Nos. 1 to 13, were carefully compared, in the part of the scale used (above 20' C.), in warmed solutions at successively increasing temperatures, with a pair of standard thermometers, made by Tonnelet, of Paris, marked Nos. 50 and 52, kindly loaned to me for the purpose by Dr. Charles F. Chandler. In these, the constants had been already determined at the Yale College Observatory. The comparative trials were carried on in the Laboratory of Microbiology of Columbia College, but need not be described in detail. The results of the comparison yielded the following corrections, which have been applied to all the observations recorded beyond.

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In the following table, the corrected figures are given from the observation note-book:
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<th>2</th>
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<td>239.2 C. 23. 24. 25. 24. 24. 24. 24. 22.8 22.8 22.8</td>
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Thermometers allowed to assume temperature of rock during three hours. In the second line, the slight increase of temperature, at a depth of 2.8 to 6.5 centimeters (thermometers Nos. 4 to 9), apparently indicates the advance of the heat-wave from the surface recently warmed by the morning sun.

North side of rock sensibly warm to hand, to depth of No. 3 (1 inch).

Stove now refilled with charcoal, in five minutes.

North side of rock warm, nearly down to No. 9 (3 inches).

North side of rock warm to depth of 5 inches. Gentle breeze.

North side warm to depth of 7 inches. Gentle breeze.

North side warm to depth of 9 inches. Gentle breeze.
Study of the New York Obelisk as a Decayed Boulder.

From these figures I have plotted the curve (Fig. 2), showing rate of penetration of heat into this stone.

Fig. 2.

From a consideration of the figures in the table, and this plotted curve, the following conclusions may be drawn:

1. That the progress of the heat-wave into the stone is curiously intermittent, with alternations of slow advances and rapid plunges, lessening however in contrast, in proportion to the increasing depth.

As the stone, though gneissoid in structure, is comparatively homogeneous, and the direction of penetration is normal to the lamination-planes, we may reasonably attribute this character of the curve mainly to the moisture locked up, in varying proportions, in the interstices of the successive layers. The increment of heat seems to be repeatedly absorbed, during a period of one-half to one hour, during the vaporization of moisture in a layer of about one centimeter in depth, and its advance thereby delayed. Then the balance of forces is suddenly broken, possibly by a lateral escape of vapor through some crevice, and a rapid advance of the heat-wave ensues during a few minutes, at first to a depth of two or more centimeters. Then comes the resistance of gathering vapor as before.

2. The determination of the rate of increment of heat, in this experiment, has been affected by several sources of disturbance and variation. The acquirement of exact and uniform figures would involve the prevalence of the following theoretical conditions: the
emission of heat of definite amount, at a constant rate, from a point, through a homogeneous medium; even thus, the rates of increment, at successive points along a radius of the spherical heat-wave projected through the medium, would evidently decrease, at a rapidly augmenting geometrical ratio with the distances from the center. In our experiment, however, the following sources of variation and disturbance must have accompanied these theoretical conditions:—

(a). Irregular distribution of temperature through the rock, before the experiment.

(b). Irregular source of heat: an indefinitely large number of points, yielding heat in varying amount and intensity. The fuel had to be re-adjusted in the stove, twice during the afternoon, with distinct influence in cooling the surface of the stone; and farther variation must have been produced by the slight breeze which sprang up in the latter part of the afternoon.

(c). Heterogeneous medium: an aggregate of several minerals of different conductivity of heat, chiefly quartz, feldspars, biotite, and hornblende: the occurrence of these minerals in crystals of varying size, lying in all positions, with interstices of irregular size intervening: separation of the aggregate into laminae of varying thickness (mostly 2 to 3 centimeters) and texture, with the biotite-plates mostly arranged in parallelism with the lamination-planes and in part along those planes.

(d). Presence of moisture in the interstices, probably in varying quantity in different layers of the rock, and producing irregular conversion of sensible into latent heat, during the production and the escape of vapor.

(e). Radiation of heat and vapor, both from the heated surface, on the east face of the boulder, and laterally from the north face.

In considering the figures in the table, the influence of these, and probably other conditions of variation, is strongly marked. Taking as a standard the average number of seconds in time required for an increment of one degree of temperature (Centigrade) to a depth of one centimeter, we find great oscillation along any line, either of depth, as marked by a particular thermometer, or of period of time, particularly of the latter. At any depth, within about 8 or 9 centimeters from the surface, the average increment of \(1^\circ\) per cm. varies from 25 to over 50 seconds, say about 36 seconds; while at any periods, passing across the columns of depth, the average increment varies up to more than 100 seconds. At the extreme depths of 25
and 50 centimeters, which also were most affected by lateral radiation and loss of heat through the north face of the boulder, the average increment lessened to a rate of over 2 minutes for 1° of temperature per centimeter of depth.

It would have been interesting to repeat the experiment from the north side of the boulder, on a series of thermometers, with bulbs lying at successive depths along the direction of lamination or strike of the boulder. Our experiment has at least thrown light on some conditions and precautions, which would require attention, in properly carrying on a series of such experiments on the conduction of heat through various species of rock, in directions varying in reference to planes of structure.

The curve presents at a glance the practical result of our experiment, that the temperature of the melting-point of the paraffin-compound (63° C.) reached a depth of 5 to 6 centimeters in about 2 hours.


With a view to determine the exact changes in physical condition in the interior of Syene granite, under the influence of long weathering, both by the conditions of the climate of Egypt and of that of New York, I have made the following experiments, with particular reference to absorptive power. The essential features of my method are founded on a distinction between two modes of absorption of liquid by a porous solid:

(a). Lateral absorption, i.e., from one surface; such as occurs in construction, when ashlar is moistened by rain upon its face. The soaking up of water is here but partial, effected almost entirely by interstices between the constituent grains, which may be distinguished as the rock-pores:

(b). Total saturation, where water is forced into all the interstices of the rock, including the more minute interstices within the constituent mineral-grains, which may be distinguished as the mineral-clefts. This therefore includes the amount of liquid in the rock-pores, and the difference enables us to estimate the volume of the second class of voids.

All kinds of mechanical strain to which a rock may be subjected (such as tension, jar, frost, etc.) are likely to develop mainly an increased volume in the rock-pores; while the irregular contractions and expansions, incident to the combinations, losses, and solutions
which attend chemical decay, tend to develop mainly the microscopic clefts in the interior of mineral-grains.

The rock-pores connect in chains of easily communicating voids, forming an intricate network which freely imbibes water, by capillary attraction, from any moistened surface, until completely filled. The communication between the mineral-clefts is interrupted and difficult, and their occupation by liquid is slow, on account partly of their minuteness and partly of their content of air, probably as a condensed film. The distinction of the two classes of voids, of their origin, and of conclusions from their proportion, seems to me important.

The apparatus and process employed for the purpose need to be first described. After some modifications, they were applied by me some years ago to a long series of trials on building-stones of this country, and were found to yield uniform and satisfactory results.

The main apparatus consists of a low bell-jar, 12 inches in diameter and 6 inches in height, with glass knob for convenient handling; this stands in about half an inch of distilled water in a large shallow tray. Within the bell-jar and half immersed in the water, is a round, soft clay tile, with even and smooth upper surface, 9 inches in diameter and about 1 inch in thickness. Before use, this tile must be repeatedly boiled in distilled water to remove all soluble matter from its interstices.

On the top of the tile several pads of sheet-rubber, 3 to 4 inches across, are laid. In the centre of each pad a square opening, 1 inch on a side, is occupied by a pad of thick soft blotting-paper, which, of course, remains constantly saturated with water drawn up from the tile. Each of the rubber pads is also kept covered with a small low glass cover or inverted dish, to prevent the fall of condensed water from the vault of the bell-jar. The water lost by evaporation outside the bell-jar is constantly replaced, so as to keep a constant level. Without a suitable precaution, the raising of the bell-jar from the water would be accompanied by a sudden inrush of water and flooding of the tile. This is prevented, either by a short bent piece of glass tubing, which passes from outside down and around the edge of the bell-glass and so up into its interior, so as to provide constant communication between the air outside and in; or more conveniently by a half-inch hole bored through the vault of
the bell-glass, closed by a cork, which is removed every time, before the bell-glass is raised.

The stone to be examined is either cut into a dressed cube of an inch on a side, or broken into a fragment of about that form and size; with either, the result seems to be the same. A sawn cube is always previously digested in ether or chloroform to remove any oil or grease possibly adhering or absorbed during the sawing or handling. All cubes are first dried in a desiccator, over sulphuric acid. Before every weighing, the cube is wrapped tightly in a doubled sheet of tin-foil of known weight.

The process consists of the following steps: The cube, on removal from the desiccator, is weighed in its tin wrapper, pressed down into firm contact upon the yielding wet pad of blotting-paper, covered, and there left under the bell-jar until filled by lateral absorption. This usually requires 2 or 3 hours, and is often indicated by little drops of water exuding upon the upper surface. The cube is then quickly pressed surface-dry in a piece of filter-paper, instantly wrapped in the tin-foil and weighed. This is repeated to insure constant weight. The cube is then immersed in non-aerated distilled water and put in the vacuum of an air-pump until effervescence ceases, again wiped surface-dry, and weighed in its tin wrapper; this is repeated to constant weight. Finally the cube is weighed in distilled water at determined temperature.

Four specimens were examined in this way, viz.:—

A. Granite from the ancient quarry at Syene, selected from a large number of specimens, on account of its fresh appearance.

B. Granite from the Syene quarry, apparently showing slight decomposition, by dulled color and lustre, and by some fine cracks.

C. Fresh granite of the Obelisk, obtained in January, 1881, soon after the erection of the Obelisk, and probably derived from chippings off the heel of the shaft, done under direction of Commander Goringe.

D. Flake of disintegrated granite, removed from surface of the Obelisk in 1885, supplied by the Park Commissioners.

The trial of these paired specimens yielded the following results:

The actual weights obtained, in grams, are given in the table beyond.
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<table>
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<tbody>
<tr>
<td>A Fresh granite, Syene quarry</td>
<td>28.539</td>
<td>28.586</td>
<td>28.595</td>
<td>17.770</td>
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<td>B Decayed granite, Syene quarry</td>
<td>68.183</td>
<td>68.365</td>
<td>68.436</td>
<td>42.755</td>
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<td>C Fresh granite, Obelisk in 1861</td>
<td>82.415</td>
<td>82.483</td>
<td>82.640</td>
<td>51.183</td>
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<td>D Decayed granite, Obelisk in 1885</td>
<td>32.735</td>
<td>32.792</td>
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From these weights the following coefficients have been calculated; a and b, in percentage of weight of the rock; c, d, and e, in percentage of its volume; and f and g, in percentage of its Total Voids.

Determinations of Absorption of Syene Granite, fresh and decayed.

<table>
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<th>Specimens tested.</th>
<th>a.</th>
<th>b.</th>
<th>c.</th>
<th>d.</th>
<th>e.</th>
<th>f.</th>
<th>g.</th>
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<tr>
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<td>.273</td>
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<td>.716</td>
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<td>.174</td>
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<td>.461</td>
<td>.759</td>
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<td>63</td>
<td>2.678</td>
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I have long hoped to confirm and develop these results, by similar experiments on a more extended series of specimens of granite from Syene, for which I have been waiting. These were to include, especially, specimens of fresh rock, to be reached by blasting from some depth below the present surface in the quarries. On these, chemical analyses were also to be made. But the recent death, in the midst of his own useful investigations, of the friend, Mr. F. Cope Whitehouse, on whose offered assistance I relied to procure this material from Egypt, has decided me to publish at once the results so far obtained.

22. The causes and progress of the decay of the Obelisk.

From the foregoing figures the following conclusions, I think, may be safely drawn, even from this limited series; though we
must allow for differences in constitution of the rock, in considering such small quantities, and for unknown variations in the length of exposure of these specimens to the weather.

(1). This granite, from whatever source derived, is by no means a compact mass, but is traversed by interstices in notable proportion, amounting to (see column \( e \) on total voids) from one-half to over one per cent. of its volume, according to its fresh character or condition of incipient decay.

In other words, even the dense Syene granite is finely spongy throughout, in its freshest state.

(2). In regard to the rock aggregate, the fresh granite (c) from the Obelisk, probably broken from the ever sheltered heel of its shaft, apparently represents either accidentally the most compact variety, or else the freshest condition of the Syene granite in my series, retaining the lowest coefficient of lateral absorption (.083), i.e., the smallest proportion of rock-pores, about \( \frac{1}{3} \) of one per cent. of the volume (.216). But in regard to the constituent minerals, the fresh granite, as just arrived from Alexandria, contained nearly 50 per cent. more voids (716 to 517) than that at Syene, chiefly in its more abundant mineral interstices. This may indicate the efficiency of hydration in the damper climate of the Egyptian sea-coast.

(3). The progress of decay of the surface chips of the granite, in the quarry at Syene, was attended with increase in the minute interstices of its component minerals rather than in the pores of the rock; the original relationship (columns \( g \) and \( f \)) 16 to 84 became 28 to 72.

This seems to show that, in the arid climate of Syene, the chief element of decay in the granite was chemical, consisting in the absorption of oxygen and water by its minerals. The limited absorption of the latter, however, is shown by the determination of the loss by incineration at 0.65 per cent., and in the microclin at 0.35 per cent.\(^1\)

(4). The progress of decay in the granite of the Obelisk, on the other hand, from 1881 to 1885, has yielded an increased proportion of rock-pores; the relationship of 70 to 30 having changed to 63 to 37. The mineral voids have increased 50 per cent. (.500 to .759), and the rock-voids have more than doubled (.216 to .461).

This indicates the action of a chemical force on the minerals, increasing their clefts, and a still more efficient mechanical action;

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\(^1\) Deless, loc. cit., 489.
the latter, between the arrival of the Obelisk at New York and the autumn of 1885, had produced a widening of the pores in the surface of the rock and incipient disintegration. This seems to me to prove that the active absorption of water, in our rainy seasons, by the minerals on the surface of the Obelisk, was the first and a continuous cause of decay. But there was, as plainly, a rendering force, apparently greater than that which can be attributed to expansion by hydration.

(5). One result of decay, both in the granite of the quarry at Syene and in that of the Obelisk during its 4½ years exposure in New York, consists in an increase of specific gravity, both in the mineral matter and in the entire rock with all its interstices. This is a further indication that the actual expansion by hydration, in the decayed surface, just referred to above, must have been very small, and that the rending force must be sought in some other direction.

The specific gravity of the granite of our Obelisk was determined by Persifor Frazer in mass, including its cavities, at 2.6618; when determined in grains of the size of a pea, at 2.7188; giving the weight of one cubic foot of the rock at 166.1625 pounds avoirdupois. According to G. W. Wigner, the specific gravity of the stone of the London Obelisk was 2.682; absorbent power of the fresh stone, at the rate of 5.4406 grams of water per square meter, and of the weathered surface at a rate six times as great.

There are only two other forces, to whose sudden application or increased action the rapid exfoliation of the surface of the Obelisk from 1881 to 1885 has ever been attributed.

One of these is our climatic variation in temperature, with frequent sudden changes within a single day, enhanced by the strong heat of the sun. But I have already shown, from the even wider ranges of temperature in the climate of Egypt, at a higher portion of the scale, and from the observed results upon the sun-exposed faces of all obelisks, that this supposed cause had little or nothing to do with the surprisingly sudden disintegration which attacked the Obelisk immediately after its arrival.

It seems therefore established that we must attribute those visible effects of decay entirely to the violent force which was then exerted upon the monolith, almost for the first time in all its history—that of frost. The power exerted by the expansion of water in freez-
ing, within the pores of a stone, is so well known, that it needs no discussion here.

It is therefore evident that, for the protection of the Obelisk from this fierce attack, it was only necessary to insure the complete exclusion of moisture.

Any process, however, in which waterproofing material is applied in solution, even to a theoretically dry stone, must be imperfect per se. On the evaporation of the solvent, which constitutes the chief volume of the solution, the outer pores of the stone, empty to a slight depth, are in large part simply lined instead of filled with the protective residue. Nor can this deficiency be supplied by further applications of the solution, in successive coats: for already many of the pores have been sealed to further permeation, and the result must be a merely superficial cellular coat. On the other hand, practically, in any large solid mass of stone or masonry exposed to the weather in our climate, the pores are already occupied, and permanently, almost to the surface, by water, even in the hottest and driest weather. This forbids the satisfactory penetration of a waterproofing solution to any material depth.

The process theoretically called for by the decaying Obelisk, in 1885, was one by which the pores of the granite should be first emptied of moisture to the depth of at least two inches, by some gently applied but long continued absorbent, such as dry air or gentle heat: and by which, secondly, the empty pores should be completely saturated to that depth with a liquid preservative, of melting-point above the mean temperature of the stone, strongly adherent, permanent under weathering, and solidifying with slightest possible contraction. These conditions were, I think, fortunately approached by the process then applied, and will be still more closely approximated by the modified process, recommended by the two Committees, for the special retreatment of the decayed spots upon the Obelisk.

As an additional means of protection to the injured surface, I have elsewhere suggested the propriety of restoring the ancient gilded cap to the apex of the pyramidion, regilding the remainder of the surface of the pyramidion below the cap, and regilding the hieroglyphic intaglio on the four vertical faces of the Obelisk. Aside from the appropriateness of this restoration from the archae-

1 The Misfortunes of an Obelisk, 128.
logical point of view, already fully discussed in the paper referred to, such an impervious metal film would serve as an efficient covering, to shed rain-water, sleet, and melting snow from the sloping sides of the pyramidion and from the hollows of the deep intaglias which cover the shaft below. To these hieroglyphs the Obelisk owes its chief interest as a historical monument, and, unfortunately, their cavities and projections, although still preserved, have suffered the chief injury by the surface-decay. The regilding could be carried out at small expense, and would be a most useful ally to the waterproofing treatment. Nothing too much can be done by our City authorities to secure both the preservation and proper decoration of this unique Symbol of the Sun on American soil, and to offset the deplorable neglect of our City, up to 1885, in its care of this magnificent gift from a generous citizen, the late Mr. William H. Vanderbilt.

Finally, then, when we return to our rusty pebble and the Egyptian boulder, what conclusions may we fairly draw as to the conditions attending their decay?

A. The main agency, by far predominant over all others, in the decay of these granite masses, has been aërated rain-water; this has been aided in Egypt by extreme and constant oscillations of temperature. Their means of action have been two-fold.

(1). Chemical, by absorption of water, together with oxygen, in combination with part of the bases of the unlocked silicates, and gradual removal of the rest in solution, producing irregular changes of volume and proportionate increase of the mineral-clefts.

(2). Mechanical, through expansion by the sun's heat and contraction by night-radiation, aided by artificial roasting in some cases, tension and jar during transportation, further washing out of soluble matters, and, in our climate, freezing: all producing increase of the rock-pores.

B. The rate of action of each process is approximately indicated by some of the facts stated:—

(1). Chemical action with a limited rainfall, efficiently aided by oscillations of temperature, has tended, in the hot and comparatively arid climate of Syene, to cause the disintegration and removal of a layer, at least one centimeter in thickness, from the surface of the granite-cliffs at Syene, during a period of five to six thousand years. Forty-five centuries have been generally insufficient to produce any visible external injury and exfoliation.
(2). Mechanical action, predominantly that of frost, has worked in the climate of New York at a vastly more rapid rate. On the surface of the Obelisk, already scarred and weakened by fire, it completely loosened a shell of about 0.73 mm. in thickness in $4\frac{3}{4}$ years, equivalent to 1 centimeter in 70 years—or more nearly 1 centimeter in 50 years, when we allow for the decayed and partially loosened material which has not been removed from the surface of the monument. But although this rate far exceeds that of the estimate of Dr. Barnard (1 cm. in 6000 years) there is no evidence that it must be continuous; the chief exfoliation has been probably already effected in the weakened, thin outer layer of stone; the main stone below is practically sound.

It appears then that an ancient column of granite like this, while unfitted to mark the flying hours on a Roman dial, may yet serve us as a true gnomon to record some phases of rock-decay at intervals in geological time.