HOW SUDD CHOKES THE NILE RIVER.

BY DAY ALLEN WILLEY.

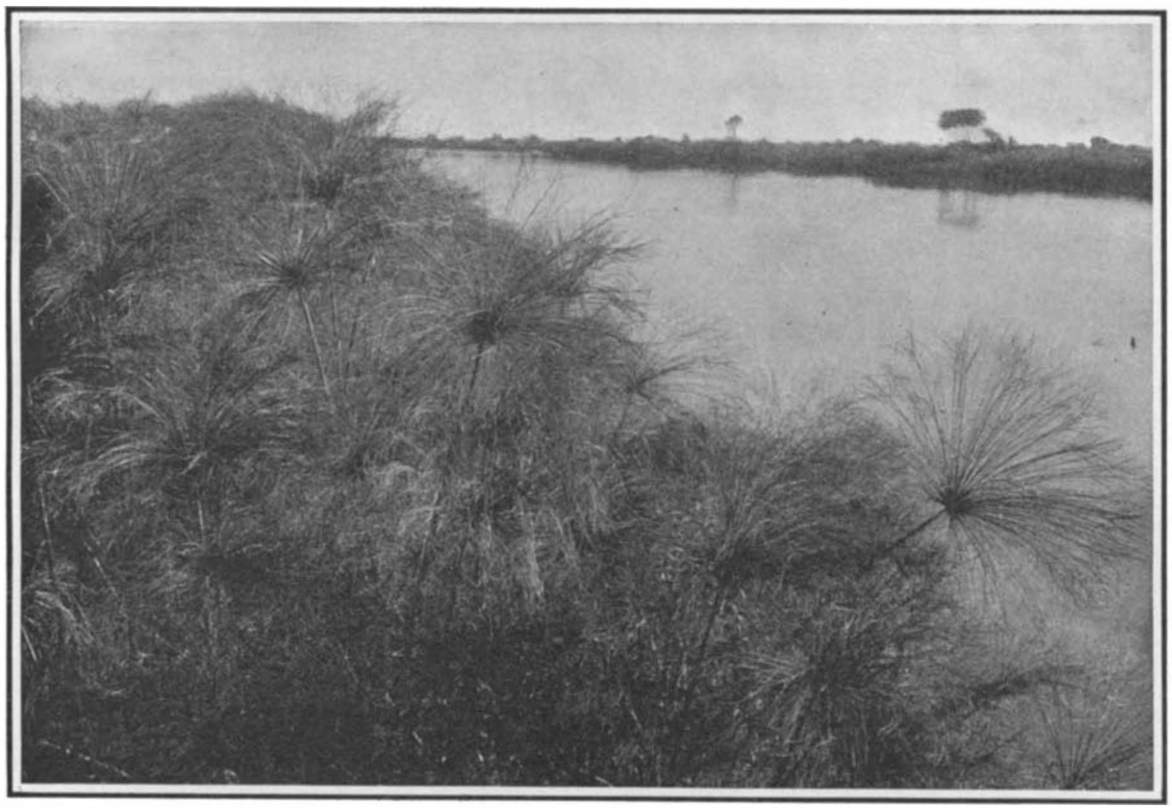
The actual head of navigation of the Nile River is considered as at the town of Gondokoro, for the reason that the depth of water is sufficient to float a steamer to the famous city of Khartoum, a distance of 1,081 miles to the northward. South of Gondokoro are stretches of water available for light-draft boats, but the interruptions to navigation are so numerous that this portion is not considered a practical route for water traffic. When Mr. Roosevelt concludes his African hunt at the banks of the Nile, his expedition will take a special steamer at Gondokoro and attempt to reach Khartoum by water. The word "attempt" can be appropriately used, for the reason that the channel may be blocked by sudd in the river to such an extent that the party must go overland for some distance if they would reach Khartoum at the date expected.

Just how the word "sudd" originated is a mystery, but every Egyptian traveler knows perhaps too well what it is, for many a time this vegetation has choked the upper Nile to such an extent that boats have been held weeks at a time until a way could be cut, burned, and pulled through it. So dense, so thick, is the water growth, that if allowed to continue, it forms a literal mat over the channel, so compact and so strong that such animals as the elephant, even the hippopotamus, have been seen to go across it, and without breaking through the matted roots, branches, and leaves. In short, the rapidity with which the sudd spreads over the water, and its parts interlace, is such that in a few weeks a space of the Nile once clear of it will be completely hidden by a mass of waving papyrus, but underneath is a combination of water plants that attach themselves to the papyrus stalks, and form what is literally a cover of vegetation, through which not a foot of the river may be visible.

In all of the thousand and odd miles from Gondokoro to Khartoum, and even above Gondokoro, does this water growth flourish, and consequently the engineers of the Egyptian government have no small task to keep open a channel for the steamer service. Although but one boat monthly plies regularly between the places mentioned, there is considerable tourist and other traffic near Khartoum, and a fleet of craft are in service to remove this curious growth. To clear a channel even large enough to admit the smaller type of vessel is not an easy task, since the sudd is so dense and so difficult to pull out—the usual way of getting rid of it. Where the Nile is wide and the water of sufficient depth, the vegetation is left untouched unless it entirely closes the channel, so a boat may make a detour of several miles out of the ordinary course, skirting one of the strange floating islands. In fact, the growth along the upper Nile is so enormous that patches of it skirting the shore may be seen for distances of a hundred miles without a break or gap to the land itself. Islands of the stuff a half dozen miles in area are sometimes carried down in the Nile flood current until they lodge against a projection of the shore or ground in shallow water. Thus it is that new "islands" of it are created often far downstream from the region where the sudd is most abundant.

In clearing the river channel of sudd the engineers have devised several schemes. The top growth frequently becomes so dry that they can burn it over like so much grass. This removes much of the weight of the plants, but they are so matted together, that saws are actually used to separate the growth, as it cannot be removed in any other way. The vessels employed for sudd clearing, while light-draft boats, are strongly built and have blunt bows, so that they can be forced against the bank of vegetation. They are provided with steel cables or hawsers, saws, and axes, and carry crews of natives who are experts in working upon the sudd.

Section of upper Nile, showing channel nearly filled with sudd.



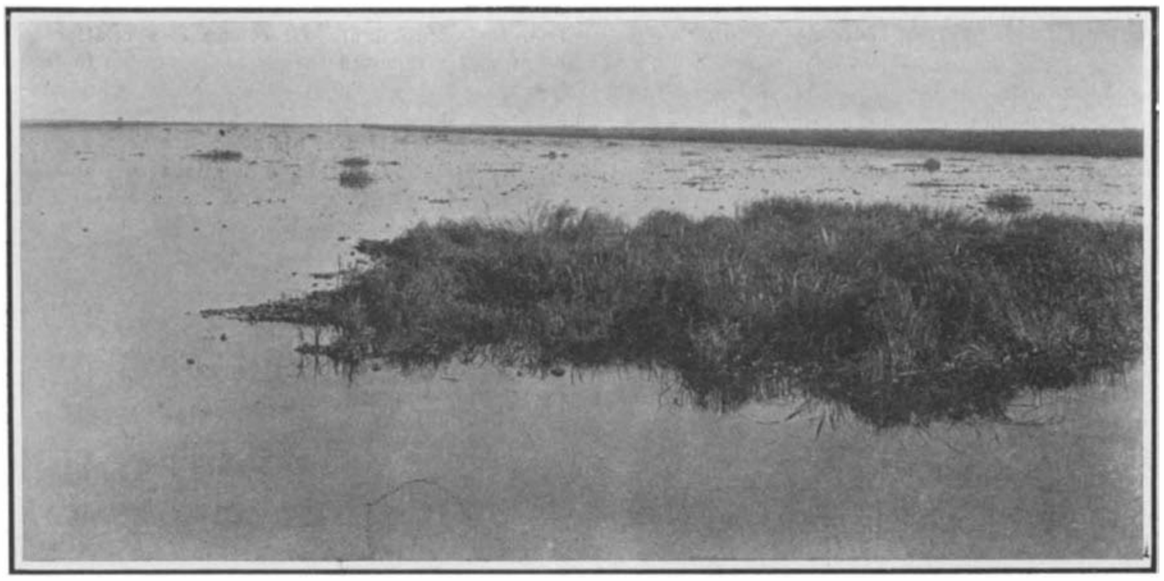
Detail view of water papyrus or sudd.

The way in which the channel is cleared is as follows: Often the water is so completely hidden, that the first difficulty when you are encountered by a barrier of sudd, is to discover where in this sudd the river bed runs. This is done by a method of "sounding" through the sudd. The average depth of water in the sudd may be only a few feet, but when the true river bed is reached this suddenly increases to a depth of 15 to 18 or 20 feet. Having found the real river bed, the first thing to do is to cut down or burn the top growth, consisting mostly of papyrus. A curious and unexplained fact noted by the engineers is that when papyrus is fired, the flame frequently spreads along what is afterward discovered to be the true bed of the river.

Having cleared the top of the sudd "block," the men are landed with large saws to cut along the true river bank, which may be either submerged with a few feet of water over it and papyrus and sudd on it, or solid ground with ant heaps, the solid ground never being of any great extent and always surrounded by swamp. Cross and parallel cuts with the saws are then made through the sudd, dividing it into blocks of a convenient size for the steamer to tear out, the size of these blocks of course depending on the consistency of the sudd and the power of the steamer.

Having cut the sudd into convenient blocks, the bow of the steamer is run into the block; the loop of steel hawser, both ends of which are made fast to the steamer, is passed over the bows of the steamer, where it is taken by the men on board and placed in what is called the trench cut, and held down with their feet. The steamer then goes full speed astern, the men all standing on the hawser to keep it in position. In the case of tough sudd, as many as twenty trials may have to be made in this way before the block of sudd eventually tears away. In the case of shallow light sudd, the hawser may be trodden down too deep and slip underneath, in which case the block will be cut free but has to be again gripped by the hawser and towed away. When the block is torn out, the steamer goes slowly astern till the mass is pulled clear into the current—if there is one—when it is cast adrift to float downstream, where it is gradually disintegrated. If there is no current, it is towed to a piece of open water, where as a temporary measure it can be tied by ropes to the bank, leaving a wide enough channel for the steamer, and on the appearance of a current, be cut adrift to float downstream.

The chief growths in the sudd are papyrus and tiger or elephant grass, a kind of bamboo growing to a height of 20 feet or more. To these climbs a creeper of a kind of convolvulus. Another portion of the sudd consists of ambatch and a long sword-grass that cuts like a knife, known as "oom soof." The steamer could cut its own way through this latter, which in the presence of a current would be broken up and float downstream, offering no obstruction. In calm water, however, it does not float away, but ob-



View of upper Nile, showing full-grown sudd and young plants appearing just above the water surface.

HOW SUDD CHOKES THE NILE RIVER.

structs the steamer by constantly fouling the paddle-wheel. There is another very light kind of duckweed which covers some of the small open pools, and in the absence of a current, is a great nuisance for the same reason.

Strange as it may seem, the sudd interferes but little with the flow of the river, and the Nile passes under it with little resistance. This is because the growth is principally near or on the surface. As the river is over a mile wide in some places, and the deep channel may be only a hundred feet, it is often hard to tell where to find the channel to clear it, as all of the water may be hidden. Men with long poles push them through the sudd to the water, and by this method of sounding locate the channel, when the sudd clearers get into operation.

The water papyrus plant so often seen in the sudd has given rise to the theory that the growth is composed of papyrus, but an analysis by naturalists shows that there are four vegetable elements that are the principal creations of this strange natural bridge. They are known scientifically as the *Papyrus cyperus*, the *Panicum pyramidale*, the *Phragmites communis*, and the *Typha australis*. They form the framework of the mass, but interlaced with them, as stated, are several species of twining and climbing plants that greatly strengthen this strange fabric. It may, as already stated, support even the weight of an elephant where it is thick enough. The papyrus with its wide top covers the sudd, and thus gives the idea that it is the only obstacle, when as a matter of fact this is a great water carpet, woven as deftly and strongly as if by the loom.

The Highest Flight of a Balloon.

The unprecedented elevation of 95,250 feet, or 18 miles, was attained by an unmanned registering balloon which was recently released at the Belgian meteorological institute at Uccle. At this elevation the barometric pressure is only 2/5 inch. The greatest height ever attained by a manned balloon is about 6.7 miles, or 35,400 feet. The Berlin aeronauts Berson and Suering, who established this record, were unconscious when they reached the highest point of their flight.

The Belgians adopted Hergesell's plan of attaching the instruments to a small and partially inflated balloon, suspended from a larger and fully inflated one. The large balloon rises until it bursts, and the small balloon falls slowly, so that it can be easily observed and brings the instruments safely to earth. At the maximum elevation, 18 miles, the thermometer recorded a temperature of —82 deg. F., but a lower temperature, —88½ deg. F., was registered at the comparatively small elevation of 8 miles. These observations appear to support the hypothesis that some of the ultra-red solar radiation is absorbed by the higher strata of the atmosphere, but additional observations will be required to solve the question.

The Current Supplement.

What is probably the very highest branch of the molder's art is the casting of bronze figures and statues. The opening article of the current SUPPLEMENT, No. 1758, discusses this art most thoroughly. The ultramicroscope and ultramicroscopic objects are discussed in simple language. Charles Engel tells something of the economy of cold in modern life. Of the many problems that confront the American housewife, the subject of vegetables for her table during the winter months is not the least important. How that problem can be solved is told by J. F. Breazeale in an article entitled "Canning Vegetables in the Home." Prof. E. H. Starling points out the lesson of evolution. The importance of ferments in organic life is dwelt upon by Dr. A. Zart. Sir Andrew Noble recently read a paper before the Institution of Engineers and Shipbuilders on the history of propellants. That paper is reprinted in the current SUPPLEMENT. "The Aerial Propeller, Its Form and Construction," is the title of an article by Lucien Fournier. Sir J. J. Thomson's brilliant paper on recent studies of electricity and matter is concluded.

An epidemic disease known as the "white" of oak has been studied recently by Griffon and Maublanc. It prevailed in France especially during 1908. The disease is properly called oïdium, and it is not confined to the oak, but also attacks the ash, elm, and chestnut. It is also found in Algeria. The disease is supposed to be due to a micro-organism known as *Microsphera alni*. The question as to whether it is indigenous or not has not been determined. It increased in France during 1907 and 1908 in an unusual way. Should we suppose it to be imported like blackrot or mildew, this would appear bad for the future, while if it is indigenous it is likely to disappear again. Some persons advocate a treatment with sulphur, but others claim that this has no effect. One important point in any case is the time of the year when the treatment is made.

Correspondence.

THE NUMBER OF OUR ANCESTORS.

To the Editor of the SCIENTIFIC AMERICAN:

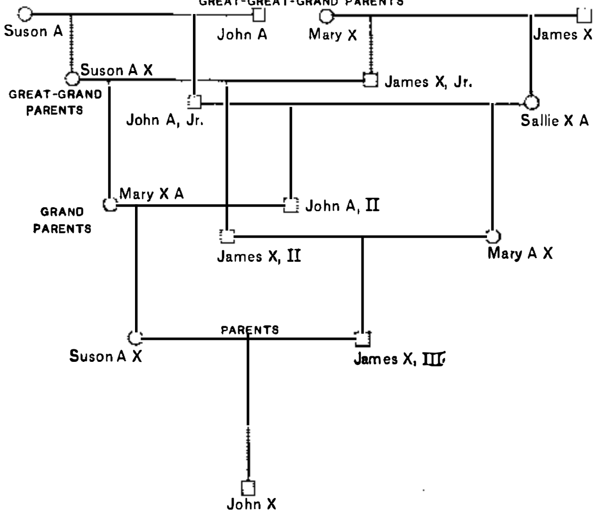
If it is not too late, I would like to add a few words to the correspondence which appeared recently in the SCIENTIFIC AMERICAN concerning the number of our ancestors.

Your first correspondent, Mr. A. K. Venning, comes to the conclusion that long before the 5,000 or 6,000 years of authentic history is reached, the number of our ancestors would be so large that there would not be standing room for them on the face of the earth; while your second correspondent, Mr. Ernest McCullough, is inclined to ridicule this, and thinks that the figuring is more apt to work the other way. Permit me to offer the following explanation: The explanation lies in the difference in the ages of our ancestors. There is usually a considerable divergence in the ages of our grandparents; and going back farther, the difference in age increases with each generation, so that by the time the fifth or sixth generation back is reached, some of our ancestors would be new-born babes, while others would be in their graves. It is readily understood from this that the number of our ancestors is just as liable to decrease with each generation, owing to the ravages of the grim reaper Death, as to increase. If our grandparents were all born the same year, all married the same year, and both couples had children the same year, Mr. Venning's conclusions would be correct, provided no one ever died. When I say grandparents in this case, I mean all our ancestors indiscriminately.

East Canaan, Conn. DEWEY C. CANFIELD.

To the Editor of the SCIENTIFIC AMERICAN:

I notice in one of your recent issues a communication from Mr. Venning of Los Angeles, Cal., in which he seeks a solution of the puzzling question of accounting for the discrepancy between the apparent



number of a man's ancestors as given by the rules of geometrical progression and the lesser number which experience shows to be the case. I think the solution is to be found in the simple fact that our ancestors have been in the habit of intermarrying with their cousins, sometimes this relationship being near and sometimes more distant. Otherwise we would inevitably enjoy our allotted number of 2^x ancestors for any given generation. Thus one set of one's great-grandparents on the maternal side are often one's great-parents on the paternal side also. For instance, a man whose ancestors for two generations had intermarried with their first cousins would have the lamentable misfortune of possessing but four great-grandparents, as shown by the inclosed diagram, when by all the rights of arithmetic he should have sixteen to be proud of. Of course this relationship is often so far removed that it is impossible to trace it, but each time one's parents have a common set of ancestors, no matter how far removed, it is evident he is being deprived of his allotted share of ancestors to that extent at least, and it might be mentioned it would be next to impossible to find any two Englishmen to-day who had not in common an innumerable number of ancestors. F. W. A.

Knoxville, Tenn.

To the Editor of the SCIENTIFIC AMERICAN:

Publication of this problem has not as yet brought any solution, but it has cleared the air to some extent, I am glad to see. May I point out to Mr. King that the question of relationship of descendants has not really anything whatever to do with the answer? He is leading the hunt off on a false scent. If we leave out of consideration altogether the present inhabitants of the earth, and start from the premise that there is only one person alive to-day—say Mr. Constable's John Brown—the problem remains unaltered, only being thrown back a few centuries.

The revised problem is: If, x generations back, John Brown had 2^x ancestors, then it is only a question of time—of a few thousand years—for the number then alive to be so great that there would not be standing room for them upon the globe. The existence of 1,500 million or so of other persons, and those, moreover, composed of different races, to say nothing of the vast animal life, only adds to the mystery. If we limit the inquiry so as to bring it more clearly within the focus of human understanding, say to 1,000 years, we find that one single Englishman alive to-day had, at the time of Alfred the Great, 1,094 millions of progenitors living at that time, as mentioned in my original letter.

Five hundred years gives a proportionally similar result, as incomprehensible and puzzling.

Los Angeles, Cal. A. K. VENNING.

THE RECENT CURIOUS ECLIPSE OF THE SUN.

To the Editor of the SCIENTIFIC AMERICAN.

The recent eclipse of the sun was both annular and total, an anomaly which becomes intelligible if we consider the data given in the American Ephemeris and Nautical Almanac for 1909, under the head of "Eclipses and Phenomena Accompanying the Same." The interesting phenomenon was not caused *per se* by the varying distance of the moon, which could not be possible, but by the varying distances on the earth where the moon's shadow or better where the shadow caused by the moon reached the earth's surface. Let me say that the phenomenon is a rare one and can occur only when the sun, moon, and earth are so situated that the moon's position with relation to the other two bodies gives it such an angular diameter that the nearest point of contact of its shadow on the earth will just cover the sun's disk, thus giving us a total eclipse. This condition we might call a critical one; for should that distance be increased by a few hundred miles between the moon and the point of contact of its shadow on the earth, there would be an apparent decrease in the angular diameter of the moon's disk, thus allowing an annulus of light from the sun to pass over its edge, and thus producing an annular eclipse.

Now this is just what happened in the last eclipse. The first annular phase was about the latitude of Tomsk in Siberian Russia in the early morning; and as the solar rays had a large angle of inclination, they had to travel much farther before they reached the earth than when the sun was in the meridian at midday.

The same conditions were present when the sun was low in the western horizon, i. e., the solar rays reached the earth's surface at a low inclination, thus repeating the annular phase on the west coast of Greenland in the evening.

Just at what points on the earth's surface the total phase commenced and ended, I am uncertain. I do not believe that the points have been worked out, owing to the fact that the duration of the eclipse at any one place would be so short that astronomers did not deem it worth while to consider it as of enough value to send an expedition, even should it have been in an accessible part of the world. As the total phase was likely all within the Arctic Circle, it goes without saying it wasn't worth while. Data are given in the American Ephemeris by which the problem can be solved for any part of the path of the eclipse.

I made a search through Grant's "History of Astronomy," and found no similar eclipse noted; but Dr. Schlesinger, director of our observatory at Allegheny, tells me that it may occur once in about a hundred years. Yet when we think of the many anomalous motions of the moon, we cannot but have the most profound respect for the mathematical astronomer who can sift out from the intricacies of these anomalies such a marvelous solution of the problem of eclipses as noted above.

I trust this note will be of some use to my old-time friends of the SCIENTIFIC AMERICAN. Too often my humble contributions on astronomical subjects are sadly distorted, and before they have traveled the rounds of newspaperdom have been made sensational, to my regret, but I am always content if I have added only a little to the sum of human knowledge and human happiness. JOHN A. BRASHEAR.

Beaumaris, Ont., Canada.

The stirring of chemicals in the solution tanks of the Oberlin, Ohio, water softening plant, states the Engineering Record, is accomplished by the use of power furnished by a Pelton water wheel. The wheel is 12 inches in diameter, operates under a pressure of from 9 pounds to 22 pounds per square inch, and consumes about 50 gallons of water per minute. The wheel drives a main shaft, which drives the stirrers, or revolving arms, through the medium of a belt. The waste water from the water wheel is used for preparing the lime solution. The speed of the wheel is 180 revolutions per minute; of the lime agitator, 38 revolutions per minute; and of the soda agitator, 13 revolutions per minute.