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bamboo-like cane give way to forests of live-oak, palm, myrtle, and mangrove islands. In the valley of Peace Creek are found the bones of huge pachydermata of the swamp epoch. In the groves and gardens, among fig and olive, grow the date, betel-nut, cocoa, and cabbage-palm. The sugar-cane tassels, and ratoons, or grows from one planting, from seven to sixteen years. Cotton becomes perennial.

When our little party first penetrated from Orange County by interior waters to the Gulf, it was all raw, wild, unknown; but since then a little steamer has gone through the Drainage Canals down the Caloosahatchee, and in another season the Northern tourist can explore the described region, and pronounce for himself upon the accuracy of the proposed theory, and the character of the land reclaimed.

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THE DRAINAGE OF THE EVERGLADES.

THE first proposal to drain the overflowed lands of South Florida was made in 1847 by Hon. J. D. Westcott, based upon the reports of General W. S. Harney, who had explored the Everglades in the Indian wars, and General Thomas S. Jesup, who had thoroughly scouted the valley of the Kissimmee and the region west and south of Peace Creek. Mr. Buckingham Smith, in the same year, made an interesting report to the Secretary of the Treasury upon the practicability of the scheme. Upon the strength of this and confirmatory reports of the army and navy officers, an act of Congress, August 12, 1848, granted the swamp and overflowed lands to the State of Florida, on condition of draining the same, the act being incorporated in a general law dedicating the proceeds from the sales of such lands, in any State where they lay, after the expense of drainage was paid, to purposes of internal improvement and education.

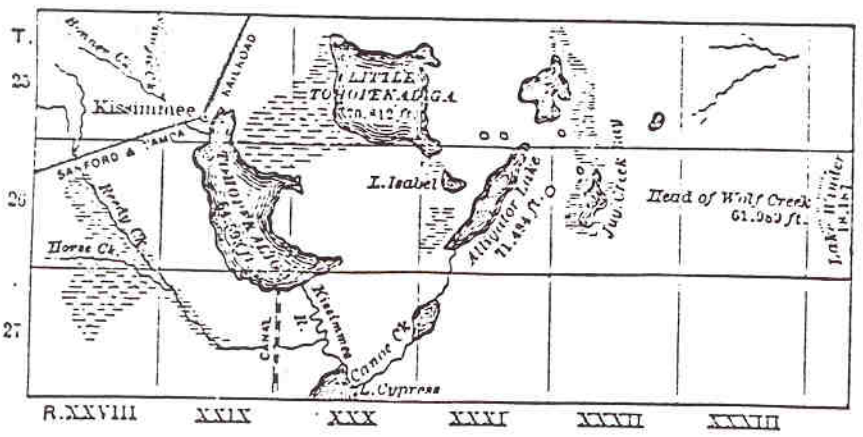
But Indian hostilities delayed active operations for ten years, and the outbreak of the civil war remanded the enterprise to the study of theorists. The slow percolation of population into South Florida, accelerated by the investment of Hon. W. M. Randolph, of Louisiana, and Hon. H. S. Sanford, ex-Minister to Belgium, in the county of Orange, which abuts upon the drainage area, was followed by the building of the South Florida Railroad, from the new town of Sanford, on the upper waters of the St. John's, to Orlando, the thriving county seat. Under Mr. James E. Ingraham's administration the road was pushed through to Lake Tohopekaliga, the summit reservoir or source of Kissimmee River. Practical and economical interests revived the study of the theorists. Careful surveys of engineers of steamboat, railway, and canal companies were re-enforced by those of the United States Topographical Corps, under an act of Congress, and the general features of the country were mapped. These, however, were disconnected, and pertaining to other interests or enterprises. Under a charter of incorporation from the State, March 5, 1879, Mr. James M. Kramer, civil engineer of the Drainage Company, entered upon a more thorough and practical survey of the area subject to drainage south and west of Peace Creek, or south of Township 25, and west of Range xxvii., including the valley of the Kissimmee and the great basin of the Okeechobee and the Everglades.

Of this region the agent of the State, Mr. S. L. Niblack, says, in his report, June 27, 1882, that the water of Lake Okeechobee does not overflow the country around the lake, except on the south, where it spreads out over the Everglades, and that the flooding of the flats of the Kissimmee River is caused by the rain-fall. In the dry season, from October to May, these vast prairies are partially drained, and pastured with thousands of wild cattle, which feed on the rich, nutritious grasses. The extent of the area south of latitude 28° thus subjected to periodic inundation from the rain-fall is estimated by Mr. Kramer at 1000 square miles in excess of the combined areas of the States of Rhode Island, Connecticut, New Jersey, and Delaware. The problem submitted to the engineers, therefore, was simply to relieve this vast territory, of

which a large proportion is not subject to inundation, but is susceptible of immediate cultivation, of the surplus water of the rainy season. This, from estimate of observations extended over eight years at Punta Rassa, near Charlotte Harbor, is annually an average of three feet eight and a half inches. In the interior the average is probably in excess of this. This quantity, distributed over a season from May to September, through sunshiny or windy forenoons and rainy evenings, is not abnormal. Any soil properly drained and aerated will rapidly absorb and utilize its daily proportion before the rainy afternoon follows. The cause of this superficial accumulation lies in the physics and topography of South Florida, and complicates the engineering problem, but without rendering it more difficult. Indeed, when it is understood, the practicability of drainage by parts becomes easy and simple in solution.

From an average elevation of two hundred feet above the sea, on the 30° 30′ parallel of latitude, the peninsula slopes by a slow, easy descent to the keys. But this incline, fifty miles wide by three hundred long, is broken into longitudinal and transverse sections of terraces. The St. John's, gathering its waters into a chain of lakes about the twenty-eighth parallel, flows north along the eastern flanks of the interior table-land, from a maximum elevation of twenty feet above the sea, to the Atlantic, near Jacksonville. A depression of a maximum elevation of eighty-seven feet above the sea divides the long slope of the interior table, in the latitude of Lake George, extending up the irregular valley of the Ocklawaha and across to the Wicassisa, emptying into the Gulf. South of this the land rises again to an elevation of one hundred and forty-six feet above the sea on the sand-hills west of Orange. This ridge, holding Lake Apopka between its arms, latitude 28° 40′, extends south sixty miles, rising, above Lake Buffum, in Polk County, to an elevation of one hundred and sixty-three feet. From this ridge and the terraces of lakes about it the Ocklawaha and the Wekiva flow north and east; the Withlacoochee north and west; the Charley Apopka and Peace Creek south and west; and the Kissimmee and Blue Jordan, a swamp river, south into Okeechobee. The rivers east of the ridge discover the peculiar terrace form of the topography; that is, the water, seeping down, pools and fills a shallow trough at the foot of the ridge, from which it overflows into a lower terrace, pooling again, and thus successively develops the chain of linked lakes exhibited by the St. John's.

The western valley shore of this river below Lake Monroe, 10.976 feet above the sea, is less than three miles wide. Sanford is fourteen feet higher; and Belair Grove, three miles inland, forty feet higher. So, going west from Lake Winder, ninety miles up the St. John's, and 18.737 feet above the sea at Charlotte Harbor, the head of Wolf Creek, ten miles in the interior, is at an elevation of 61.989 feet; and Lake Conway, on the highest terrace of Orange County, one hundred feet above the sea, having no visible outlet, seeps through



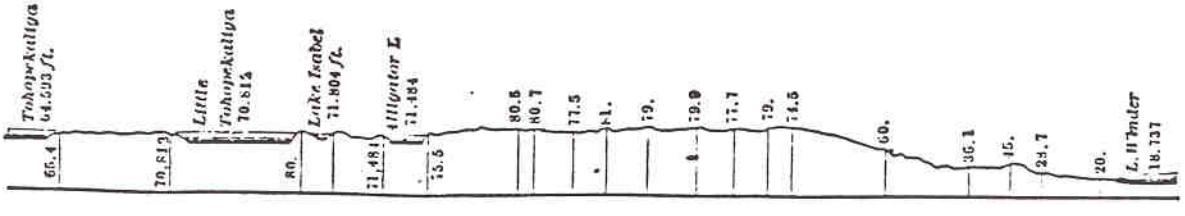
MAP OF THE TOHOPEKALIGA SUMMIT LEVEL.

swamp and marsh to Little Tohopekaliga, a fall of twenty-nine feet in less than ten miles. These various examples of river marsh or upland lake indicate that the terrace form of the topography of South and East Florida is not a local incident, but a general characteristic. Of this simple explanation of that accumulation of superficial water the engineer avails himself in order to drain these terraces successively. Otherwise, if the flooding of the prairies was caused by the overflow of a single grand reservoir of the valley at Okeechobee, the drainage would be accomplished by enlarging its outlets. Over these the long rain cloud from May to September unburdens its fruitful showers, filling and overflowing terrace over terrace, from each of which the freshet falls, not into the single channel of one mighty river, but down broad, shallow valleys, overspreading the wild pastures that fringe the central basin; and, combining with its gathered volume of increase, stays the slow drainage and evaporation mayhap from season to season. When this occurs, and the redoubled freshets of each successive terrace unite with the combined volume of the Kissimmee River in Lake Okeechobee, the overburdened banks give way to the impetuous floods, which in 1841, '48, '55, '62, '69–'70, and '74 drowned the palm groves of the Caloosahatchee.

But when the dynamics of this system of terraces is understood, it becomes a key to the solution of the problem of drainage. The engineer is not left to the alternative of reducing the volume spread over twenty thousand nine hundred square miles at once. He can proceed from terrace to terrace, reclaiming the higher ones by successive descent, step by step, while the drainage of the central basin proceeds as an independent operation. This can be best illustrated by the maps. The one above includes the region west from Lake Winder, on the St. John's, Township 26, Range xxxv., and extends westward six townships. The general elevation of this table above the sea at Charlotte Harbor is 66.82 feet. The highest basin is the small lake in Township 26, Range xxxii. The summit ridge is in Range xxxiii. The general contour of the terrace is represented by the topographical chart below, reduced from the surveys of Assistant-Engineer W. G. Williamson, of the United States Topographical Corps. It does not represent an air-line, but the depression of lake surfaces, after crossing the divide between the valley of the St. John's and the summit level. The distances from Lake Winder and the elevations above the sea at Charlotte Harbor are given in the following table.

	Distance from Lake Winder in Miles.	Elevation above the Sea at Charlotte Harbor in Feet.
Lake Winder	00.0	18.787
Head of Wolf Creek.	10.11	61.989
Alligator Lake	28.40	71.484
Isabel Lake	31.41	71.804
Little Tohopekaliga.	37.32	70.812
Tohopekaliga	52.98	64.593
Cypress Lake	58.81	64.593
Hatchenaha	66.81	60.235

Neither of these represents the topography in its general character, until we understand that, as the Tohopekaliga sum-



SECTION OF TOHOPEKALIGA SUMMIT LEVEL.

mit level is a terrace of the high table-lands of Orange and Polk counties, it is itself divided into subterraces sixty feet above the sea, extending like a flare edge from the head of Wolf Creek (61.989 feet) to Lake Hatchenaha (60.235 feet).

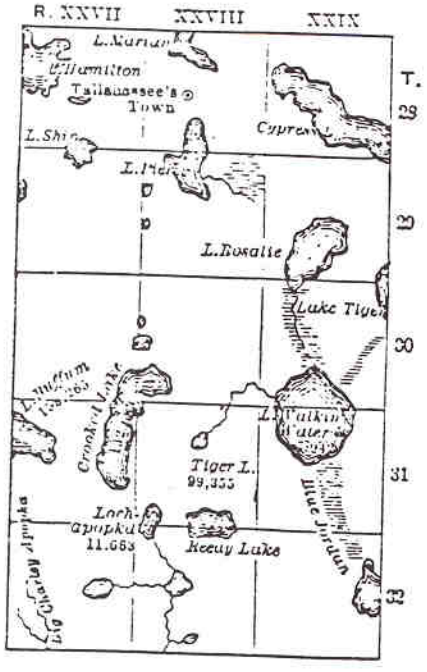
The lake surface of this summit level is fifty-three square miles, but swamp and "bay" (the word applied in Florida to slough and water-grass meadows) amplify the area to 250 square miles. It is 45.856 feet above the valley of the St. John's, and is succeeded on the south by the lower terrace of the Kissimmee lake and river.

The fall from the summit level to the escarpment of Wolf Creek and Lake Hatchenaha, or Turkey Lake (to render the Indian into English), is nearly five feet in three and a half miles. A canal forty feet wide and six feet deep was projected, and has been completed, connecting the latter with Tohopekaliga. This furnishes a fall of nearly two feet to the mile. Omitting the figures, it is calculated the discharge of such a current will require an area of rain-fall in this region over three thousand square miles, independent of evaporation, to keep it supplied. A most important function of such an aqueduct is its service as a catch basin for the supersaturated soil.

The Drainage Company was reorganized in 1881, under the presidency of Mr. Hamilton Duston, who had previously invested heavily in the reclamation and settlement of South Florida. The preliminary surveys under Mr. Kramer were completed in the summer of 1882, and Captain Rose, an experienced engineer, organized his company, and built the hull for his dredge in the raw woods on Lake Tohopekaliga. The patent (Allan's) is on the continuous ladder principle. A chain of buckets, suspended from an upright of forty feet, is drawn under a drum at the extremity of an arm extending forty feet horizontally from the foot of the upright, and over an incline to its top. The whole has some resemblance to a figure 4, having a short foot resting on the bow of the scow. The chain of buckets revolves over the drum, sinking their steel scoops in the soft ooze and muck, to ascend over the incline to the top of the 4, where they are met by a washer from the two-inch nozzle of a force-pump as each bucket falls over, with a jerk, discharging its contents on a sluice-gate, at right angles to the keel, extending beyond the edge of the cutting, and building its levees as it progresses. The long arm swings on the stem of the 4 from side to side, controlled by levers, so that each bucket sinks beyond the previous one, digging or cutting a swath of thirty-seven feet, as a mower swings his scythe. A tow-rope over a drum, attached to a stake properly set for the width and rectilineal edge of the cutting, controls the progress by means of levers. The huge crane swings; the timbers groan; steel and iron rattle and clang; the cough of the engine is broken by shouts of the men up to their waists in water; the anvil clinks; the sharp word of command cracks like a cow-whip; the constant stream of black ooze pours over the sluices; and as the huge iron and steel megatherium, like its prototype, toils deep in the marsh, behind it is the clean-cut edge and levees of the new canal. The scow on which these operations are conducted is a stern-wheel steamboat, having a narrow cabin for the accommodation of the men, and a smithy. Only white labor is employed.

The scenery is like its prototype of the coal period, a sea of maiden cane embroidered with bay and cypress where Reedy Creek and the tortuous Kissimmee cross the watery prairie. Here we find ferns, and pig-weed six inches in stem, and wearing a huge flower like a hat; while saffron, morning-glory, jasmine, water-lily, sparkle among the green of vines and the gray of tillandsia. The ardor of vegetation is everywhere magnificent in its richness and variety of color and tones. The drainage has already reclaimed nearly 400,000 acres, acknowledged by grants under the contract, chiefly in this summit level.

The terrace of Orange County south of Township 25 abuts upon the superior table-land of the adjacent area in Township 29, Range xxx. This territory, as indicated by the range lines on the map, lies southwest of that which we have examined, which it overlaps. It includes an area of 576 square miles, containing numerous small bodies of water, arranged on ascending subsidiary terraces as we go west from Lake Kissimmee. The average elevation above the sea at Charlotte Harbor is 106 feet. In the vicinity of Lake Buffum the high peak of the sand-hills divides the waters of Peace Creek and Charley Apopka from the water-shed of the Kissimmee Valley. The larger lakes



MAP OF THE LAKE BUFFUM SUMMIT LEVEL.

in order from the north, are Pierce, Rosalie, Walk-in-Water, Kotsa, Crooked, Buffum, Reedy, and Lochapopka. It includes the farm lands proper of the Tallahassee Indians, removed south of Micanopy half a century since, of which a remnant survives.

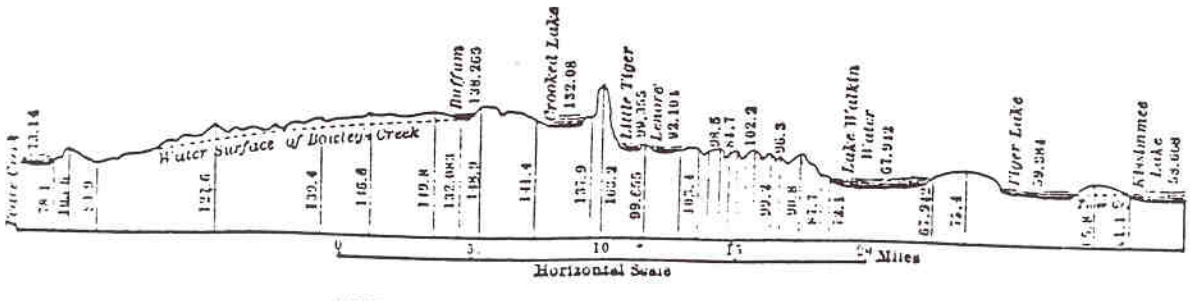
The topographic chart below, reduced from Mr. W. G. Williamson's report, exhibits a cross section of the pools and narrow longitudinal valleys into which the region is subdivided. The following table gives the heights and distances:

	Distance from Lake Kissimmee in Miles.	Height above the Sea at Charlotte Harbor in Feet.
Tiger Lake.....	2.01	59.384
Walk-in-Water ..	5.51	67.942
Lake Lenore.....	16.76	92.104
Lake Little Tiger.	18.18	99.355
Crooked Lake....	21.73	132.683
Lake Buffum	26.16	138.265

The engineering in this region is reduced to the drainage of the long accumulation of surface water by the gradual filling of its outlets by vegetation. It is entirely apart from the relation of the adjacent terraces to the system; but the chart shows its peculiar adaptation to practical irrigation by means of locks and dams. The planter and fruit-grower may here, as in Orange County, be made independent of the weather by these small adjacent bodies of water situated on different levels.

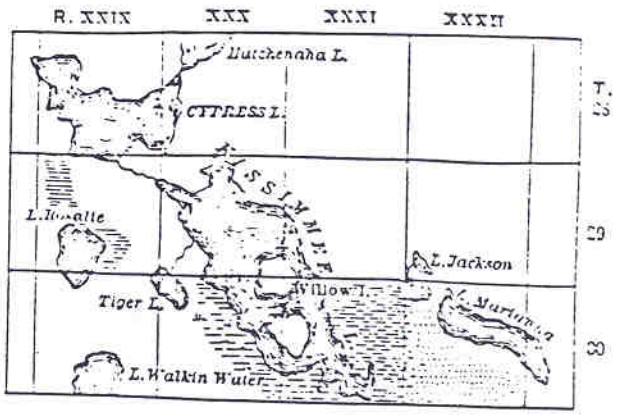
In the angle between the regions mapped, Townships 29 of Ranges xxx. and xxxi., lie the beautiful lake and valley of the Kissimmee, extending eastward to the St. John's. Nothing appears more striking to the observant explorer than the sharp distinction in nature between adjacent territories through which he passes. As he goes southward from Lake Kissimmee he leaves behind the prevailing characteristics of high pine level, hummock, and prairie of crab-grass. Before him, like a sea, rolls the lustrous pale yellow cane, having a long silky plume, through which the river winds, inextricable errors involute, like a labyrinth. In the remote horizon is the bronze fringe of red bay, the deep green of live-oak, tufts of palm, or the tawny fronds of the pine, melting into the kaleidoscope of cloud-land, by which the trained eye distinguishes at a glance elevation above the water. On that sallow or gamboge ground-work the courses of streams embroider an arabesque in green willow and custard-apple. The heavens are opened, tinged with iridescent hues, like the nacre of a shell; the abundance and plumage of wild fowl increase. The deer feed with a "shocking tameness," wild turkey seem domesticated, and fish are taken without trouble or skill.

A low swell of the ground, rich in crab-grass, extends south, by Fort Drum, Range xxxv., Township 34, to the vicinity of Fort Van Swearingen, and the heads of Taylor and Cow creeks, which empty into the Okeechobee. Of this Mr. Niblack, in his report to the State Board, June 27, 1882,



SECTION OF THE LAKE BUFFUM SUMMIT LEVEL.

says. "Within this limit there is, in the vicinity of Fort Drum, a pine ridge, five miles in length and one-half to three-quarters in width, that might with light drainage be cultivated." There is, he adds, a ridge about Fort Davenport, west of the Kissimmee, T. 29, R. xxvii., four or five miles wide, extending south to Lake Istokpoga, T. 36, R. xxx., said to be barren and uninhabitable. All the rest, according to Mr. Niblack's report, is subject to overflow.

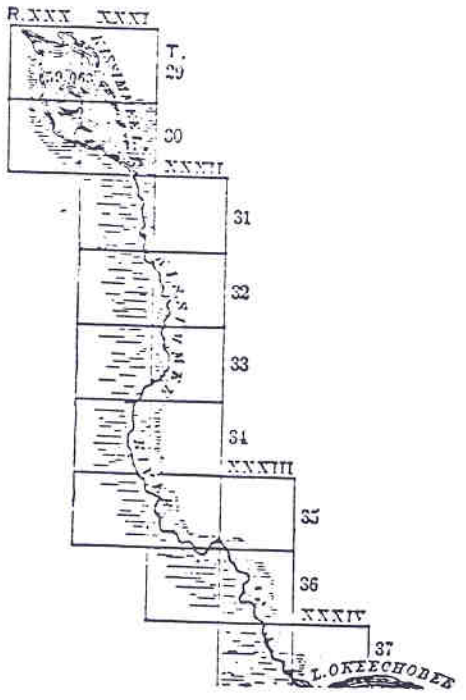


LAKE KISSIMMEE.

But on an excursion in probably the more favorable season of December, 1882, the writer found pine levels and arable land quite down to the vicinity of Okeechobee. The most singular curiosity of his exploration was a swine-herd brought up in that wild, trackless region, and yet whom no curiosity, or the chance wandering of his herds, had led to the mouth of the Kissimmee, a few miles below. He had "had no 'casion for to go thar," and he never went. I fancy it was a more vigorous race than the swine-herd held these watery fastnesses for forty years against the combined army and navy.

Nothing could appear more queenly and magnificent than Lake Okeechobee as we came upon it. The closing day was drawing the soft veils of dusk over the pinnate and pointed foliage set clear against the dying lights.

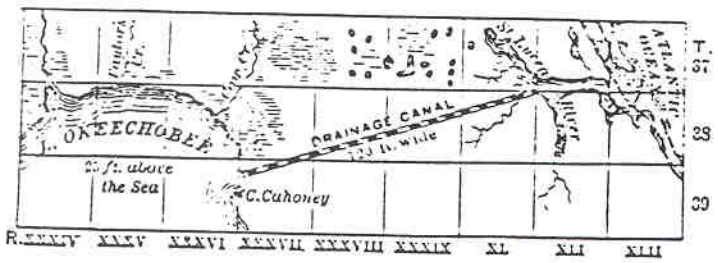
The river is one hundred and twenty feet wide at the mouth, flowing with a mean velocity of two feet per second, ten feet deep, discharging 207,360,000 cubic feet every twenty-four hours. On an estimated evaporation of one-eighth of an inch per day, the exhalation would aggregate 290,400,000 cubic feet, or 83,040,000 in excess of the inflow of the Kissimmee. Hence it is estimated that in only abnormal conditions the great lake overflows its margins. But these estimates do not include the inflow from other terraces, which fill the valley of Fish-eating Creek on the west, and Cow Creek and Taylor's Creek on the north and east, whose combined volume will probably counterbalance the normal evaporation of three-eighths of an inch per day.



VALLEY OF THE KISSIMMEE.

To control this, a proposed canal from Cahoney Bay, in Okeechobee, to the St. Lucea, is to be cut one hundred and twenty feet wide and ten feet deep, having a fall of one foot per mile, with a mean velocity of 3.86 lineal feet per second, capable of lowering the estimated thousand square miles of surface four feet in a season.

It would require too much space to distinguish the botanical characters of vegetation in this virgin area; but the economy of nature is exhibited in the increase of leaf surface by atmospheric nutrition, displayed in gigantic ferns, palms, and the massing of delicate pinnate foliage in the bay, cypress, and their congeners, like the refinement of art in nature. These, shining, pointed, or darkly varnished in the willow and custard-apple, show a thousand tones and shades of green, which catch the lights and shadows in innumerable angles and surfaces, developing an extraordinary brilliance and softness. The great basin is a shallow pool on the oolitic limestone, in a frame of saw-grass,



MAP OF OKEECHOBEE DRAINAGE CANAL.

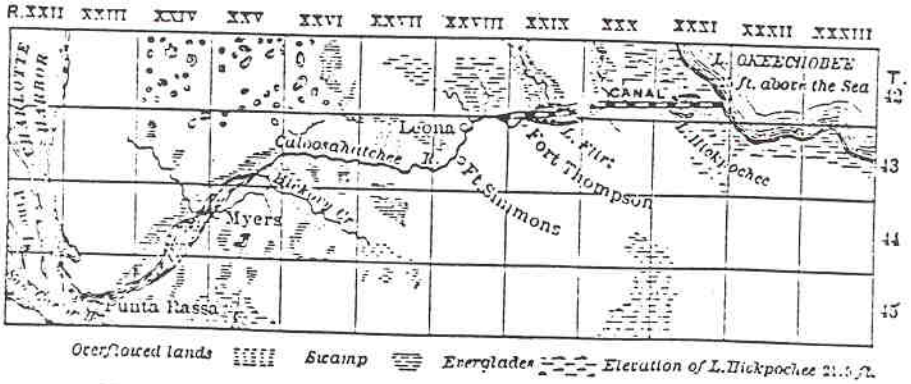
whose pale straw-color is brought out against the distant vaporous, velvety bronze and green of the red bay. It sits on a stool twenty-five feet above the sea, and five feet above the terrace of the Everglades. We crossed under a high wind, December 9, from the Kissimmee to the mouth of the Drainage Canal.

The axe-men had penetrated the fringe of custard-apples, and revealed through the opening the welcome pillar of smoke

ond canal through the soft chalk rim of the outer basin. Curiously Captain Menge, engineer of the dredge, found here the remains of an old cut of the Spaniards, showing that even the project of drainage of Governor Westcott was not the first.

An earlier United States survey makes the fall from Fort Thompson, at the southern extremity of Lake Flirt, to Charlotte Harbor, less than two feet. This would make a descent from the chalk ridge of the outer basin of Okeechobee—a distance of ten miles—two feet to the mile. It was found necessary to dam at that point in order to get water to float the dredge-boat.

South of Fort Thompson is the beautiful current of the Caloosahatchee, flowing between high banks, terraced in the characteristic manner of the topography.



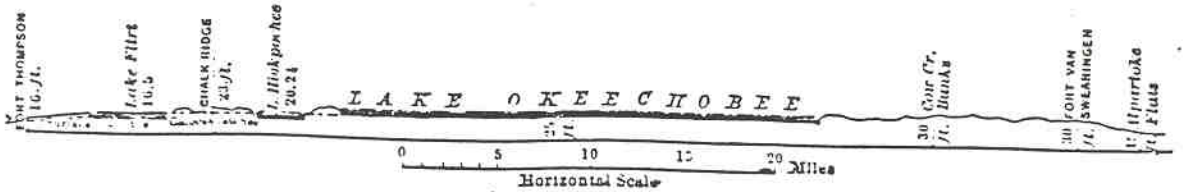
CHARLOTTE HARBOR AND THE VALLEY OF THE CALOOSAHATCHEE.

of the dredge. The stratification as developed in the cutting beginning from the bed-rock is clay and marl under white sand, overlaid by a deep bed of muck. The depth and rankness of this superficial deposit are extraordinary. It needs no scientific acumen to discover that the successful drainage of such a deposit will develop an area of fertility unrivalled even by the loamy bottoms of the Mississippi.

A canal twenty-two feet wide, having an average fall of one foot to the mile, connects Okeechobee with Hiokpochee, and this is connected with Lake Flirt by a sec-

This feature, peculiar to all river valleys, indicates the manner in which the grand trowels of nature have built up the watershed of all South Florida. Here in the soft marl or loam are exhibited everywhere the escarpments seen in the harsher features of parallel roads in the geology of more northern latitudes. In that is the explanation of the overflowed lands of Florida, and the key to their successive drainage, terrace by terrace, to the Everglades.

Again the scenery has changed. The tall silken plumes of the saw-grass and



SECTION OF BASIN OF LAKE OKEECHOBEE.