

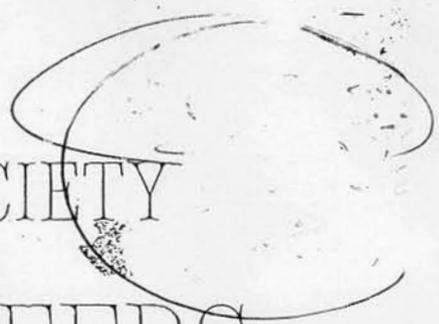
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PROCEEDINGS

OF THE

SOUTHERN SOCIETY

CIVIL ENGINEERS



Annual Reports for 1885 and 1886,

WITH

PROFESSIONAL PAPERS.

No. 3.

DACOSTA PRINTING AND PUBLISHING HOUSE
JACKSONVILLE, FLA.
1887.

Southern Society of Civil Engineers.

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The rooms of the Society, and the office of the Secretary, are at Nos. 4 and 5 Bostwick's building, foot of Pine street, Jacksonville, Fla.

MEETINGS.

REGULAR MEETINGS.

On the third Monday of each month, at 7. P. M., standard time.

ANNUAL MEETING.

Third Monday in January.

FEEES AND DUES.

	<i>Seniors.</i>	<i>Juniors.</i>
Entrance fee.....	\$ 5.00	\$5.00
Annual dues.....	10.00	5.00

It is requested that all changes of address be immediately communicated to the Secretary.

cause of want of punctuality, *i. e.*, the separation of members at distant points.

The elaborate digests of the French and Italian administrations of public works, on which I have been engaged for Council Engineering Society; the terrible earthquake, which has caused so much disaster and loss in every way imaginable, disturbing the usual business routine and moving bodies to and fro out of line, not only moved me out of line of reports, but made my duties much more onerous.

Regretting that I cannot attend to the duties, being so far removed from headquarters and other members of the committees, I tender my resignation as chairman, and shall be glad to act as a member of the committees and contribute the result of my past study, as well as what I may do in future, to the cause of the advancement of the Society, in which I feel the deepest interest.

Hoping I may look for the indulgence of our honored President and Society, and relying on your kind feeling, I remain

Very truly yours,

LOUIS J. BARBOT.

DRAINAGE OF THE SARASOTA SAW-GRASS.

Report of J. F. LeBaron, of the Committee on Drainage and Reclamation. Read before the Society, at the adjourned Annual Meeting, February 21, 1887.

H. S. Duval, President Southern Society Civil Engineers.

SIR: I have the honor to submit my first annual report on Drainage and Reclamation, for the year 1886.

The only work of this kind that I have had the opportunity of personally inspecting during the last year, is the drainage of the Sarasota Saw-grass, in Manatee county, Florida, by the Florida Mortgage and Investment Company, (Limited.)

This work is situated about three miles east of the new town of Sarasota, on Sarasota Bay, and was conceived by Mr. Piers E. Warburton, late General Manager of that Company, and carried out under his general direction and the immediate supervision of Mr. D. R. Greene, Mechanical Engineer, of New York. Levels were taken by Mr. W. H. Garrett, Civil Engineer, and

Mr. H. C. Litchfield, Civil Engineer. Latterly Mr. Richard Paulson, the Company's Engineer, has been in charge. The fall was found to be 6.5 feet from the surface of the saw-grass to tidewater in Phillip's Creek, and the distance 7,000 feet. Phillip's Creek is five miles long in a direct line and empties into the northern end of Little Sarasota Bay. The distance by the sinuosities of the creek is probably twelve miles or more. A ditch was dug from the upper end of this creek, where the width is about six or eight feet, to the lower end of the saw-grass pond, and thence up through the middle. This ditch was 3,000 feet long and the creek was widened and deepened about 4,000 feet, and some of the points cut off, straightening it.

The main ditch is 12 feet wide on top, 6 feet wide on bottom and 4 feet deep, giving a side slope of $\frac{3}{4}$ to 1 foot. The material was thrown up on each side. The work was all done by negroes, with shovels, under contract, and the total cost of the main ditch and outlet was \$650, and it is stated that the contractors made \$2.50 per day, or nearly 7 cents per cubic yard, estimating the outlet work the same as solid ditch, which is largely in excess, for the outer work consisted in deepening in some places not more than 2 feet, and straightening a few narrow reaches. A nearer estimate would be about 12 cents per cubic yard, for earth actually removed.

The area of the saw-grass pond was stated to be 500 acres, of which only 200 belongs to the Company, the balance belonging to different individuals who are benefited by the operations of the Company without any expense to themselves.

The drainage area or water shed was stated by Mr. Greene to be about 3,500 acres.

The ditch was planned to carry off 4 inches of rainfall in an hour, as stated by Mr. Greene. The land is laid out into 5 acre lots fronting on the main ditch about 350 feet. Each one of these lots is surrounded by a ditch, on its three sides. The sub-drain is 3 feet wide on top, 1 foot on bottom, and three feet deep. They were dug by contract for \$25.

The surface of the saw-grass is apparently level. At the time of my visit, December 28th, the soil was dry and friable for two inches below the surface. It then commenced to grow moist and at six inches water could be squeezed out in the hand. I caused a pit to be dug on the drained land and found water about two feet below the surface about the same height as the water in the ditch. The soil is a black, mucky peat, growing finer and more decomposed as you descend. The top is quite light and porous. The black, peaty soil extends for a depth of three feet. Then a layer

of sand about six inches thick is encountered and below that a layer of fine, soft, sandy marl, unctious to the feel, about eight or ten inches thick and then sand again. At the period I visited the land, this region had experienced a dry time of about two months. English peas, radishes, and turnips, were growing nicely, and Irish potatoes were being planted. The main ditch was completed in June, 1886, and the land appeared to be completely drained. A small stream was running out of the side ditches, and the water stood about two feet deep in the bottom of the main ditch, owing to improper grade; no grade stakes were set, and the contract called for the ditch to be four feet deep. At the lower edge of the pond the ditch passes through a narrow neck of palmetto-flat which is higher than the average level of the saw-grass, and so the bottom of the ditch is higher here also.

The saw-grass, in its natural condition, was evidently very soft and boggy. The Superintendent told me that when they commenced work that a horse would sink at one step to his body, but at the time of my inspection I rode my horse easily over it.

The main drain was completed in June, and last fall, five acres of the land about in the center of the pond was broken up. It was then found impossible to do this with horses, as they bogged in the rich muck, but it was easily accomplished with oxen. No grubbing was required. The saw-grass was simply mowed down before putting the plow in. It could be burned but if dry there would be danger of much of the soil burning up with the grass, it is so peaty.

The total cost of this drainage, including the side ditches, is \$6.30 per acre, making it by far the cheapest land in Florida.

The company propose to cut an intercepting drain all around the pond on the edge next the pine land, to catch the surface water and seepage from the higher lands, and although this is contrary to the theory and rules of land drainage as laid down by French and Wareing, I believe in this and analogous cases that it will be desirable and efficacious. I was led to this opinion by observing that near the edge of the pond, my horse sank deeper and the ground appeared more moist.

The theory of drainage is that the lines of the drains should follow the natural lines of drainage as shown by the superficial contours, and never be at right angles to them, but in this region the differences of level are so very slight, and so much water is brought down during the rainy season from the almost level pine lands, that I think the rule, which is a good one in comparatively hilly countries, should be modified in this country, where lands are so nearly level.

The outlet of this drainage system requires immediate and careful attention. Unless the outlet is free and lowered the whole system is clogged. In this case it was never made deep enough, and the creek was not thoroughly straightened as it should have been. After the completion of the work, and during the last rainy season, the banks of this creek were overflowed, and the water swept across the bends. Unless these sharp bends are straightened and the creek thoroughly cleaned out to its mouth, the work already done will be jeopardised and probably rendered nugatory.

I think the outlet of the main drain should be calculated to deliver the rainfall of at least 6 inches in not more than 1 hour from 500 acres. I do not think four inches enough. The grade of the bottom of the ditch should be made uniform at 1.88 per mile, which is all that can be obtained.

Trautwine gives a table for the mean velocity in feet per second in a rectangular channel 10 feet wide and 4 feet deep at 2.27 for a fall of 1.5 feet per mile and 2.64 for 2. feet per mile. By interpolation we obtain 2.55 feet per second for velocity, with a fall of 1.88 with a proportionate discharge of 102 cubic feet per second, or 367,200 cubic feet per hour.

A rainfall of 1 foot on 500 acres would amount to 1,773,000 cubic feet of water to be disposed of after filling the ditch and without making any allowance for absorption, would require nearly 5 hours to run off, but owing to the extremely porous and absorptive character of the soil the water would permeate the soil, almost instantly, leaving a very large and almost unknown margin of safety. In case, however, of a heavy rain following within a few hours of another, a case might occur, where the subsoil was already surcharged with water, which had not had time to run off. In order to prevent any possible overflow the main drain should be made large enough to dispose of this rainfall before it could rise above the land. This would require for a precipitation of 6 inches in 1 hour a ditch 100 feet wide and 4 feet deep, allowing about 3 hours for the water to run off, and not supposing any absorption. However, in the light of previous experience here during the last rainy season, it would appear that the main ditch was probably large enough to carry off the water, under ordinary circumstances, provided the outlet was properly preserved and maintained.

The result of this experiment will be looked forward to with great interest, for there are millions of acres of these lands in Florida. The land when relieved of this surplus water appears capable of bearing immense crops without exhaustion. It is at first sour from a superabundance of crenic and apocrenic acid,

but this is neutralized by the application of lime which was being used here.

Very respectfully, your obedient servant,

J. FRAS. LEBARON.

COUNCIL OF ENGINEERING SOCIETIES ON NATIONAL PUBLIC WORKS.

Report of Louis J. Barbot, Delegate from the Southern Society
of Civil Engineers to the Cleveland Convention.

(*Read before the Society May 17, 1886.*)

CHARLESTON, May 14, 1886.

*To the President and Members of the Southern Society of Civil
Engineers:*

GENTLEMEN—It is my pleasing duty this evening, as the representative of the Southern Society of Civil Engineers to the Convention of the Civil Engineers' Committee on National Public Works, to say a few words about the Convention, which was held at Cleveland, Ohio, March 31, 1886, to transform the temporary organization into a permanent organization and define its character and policy. For the action of the Convention during its session, I respectfully direct your attention to the printed proceedings, which I had the honor to transmit to our worthy Secretary for distribution among the members, and for the character and purpose of the permanent organization, inaugurated by delegates from the several engineering societies of the United States, I would refer you to the very able address of the Executive Board of the Council of Engineering Societies, prepared by L. E. Cooley, President.

During the period of four months, extending from the date of the temporary organization, in the month of December, 1885, to the date of its transformation into a permanent organization, in the month of April, 1886, the Executive Board, through their zealous and indefatigable co-worker and Secretary, Wm. T. Blunt, had an extensive correspondence with and issued information in form of bulletins to the chairmen of the National Committees on Public Works of all the engineering societies of the United States, who transferred such papers to the secre-

an outside matter. The Convention could not, as a body, consent to take up the subject for discussion, for it did not feel that the patriotic thought which had brought us together, for the purpose of devising and recommending to the Government a proper system for the administration of its public works, admitted the consideration of any questions of personal or class character. The Convention had the interests of the country at heart, and designed the result of their labors for the general welfare of the people, and the advancement and development of the United States. It was not a conference to determine the matter of employment and jobs for the profession at large.

The status of civil and army engineers has been as fully discussed in all the engineering journals, magazines and newspapers,* and all the arguments advanced being so fair and plain dealing, will operate as a powerful lever in favor of the passage of a bill by Congress, based upon the recommendations of the Council of Engineering Societies of the United States.

The Executive Board in their addresses of January 5th, 1886, and of May 26th, 1886, the able report of E. L. Corthell to the Engineers Club of Philadelphia and his letter of March 27th, 1886, to the Cleveland, Ohio, Convention, have all fairly shown the question in its proper light.

There can be no doubt, gentlemen, of the ultimate success of our plan, for it is too evident that the present system of carrying on the public works of the Government has failed in its practical results, and both the people and the Government, will only be too ready to adopt a system which shall meet all the exigencies of the case, and be productive of practical results.

Very respectfully,

LOUIS J. BARBOT,

Mem. So. Soc. C. E. Delegate, Cleveland, O., Convention.

PROFESSIONAL PAPER NO. III.

The Construction and Maintenance of Wagon Roads.

By M. L. LYNCH, READ BEFORE THE SOCIETY, SEPTEMBER 20, 1886.

The condition of our public highways is such that serious consideration of the subject, with a view to their permanent and sys-

*Engineering News, Vol. V, page 329. Lippincott's Magazine, August 1883, p. 159. Engineering Era, April 1885. Cleveland Plain Dealer, April 1886.

tematic improvement can no longer be deferred, especially when the rapid development of the agricultural and manufacturing interests of this section is taken into consideration.

The philosopher has said that a leading test of the civilization of a people was the condition of their public highways, citing the Romans and other Nations as examples; this may be true in the abstract, but due allowance must be made for the people of a new country, until sufficient time has elapsed to enable them to acquire the means, and devote the necessary time to public improvements of a permanent character.

Believing the time has arrived when a discussion of the subject would be of advantage, the writer respectfully submits this paper for the consideration of the Society, entering briefly into the engineering principles involved, and reviewing the subject in general, with a view to a thorough discussion by those whose professional training and experience, fits them for the consideration of this important subject. and to the end that the result may be an improvement for the crude system now in force, by placing the matter in the light that its importance deserves before the people and legislatures of the various States through which our membership exists.

Coeval with the construction of an abode for shelter, the labor of the primitive man was directed to the opening of paths, trails, or roads for purposes of intercommunication, and as communities increased in population, laws governing the subject were formulated, the same condition with certain modifications existing to the present day.

In some of our States the roads are maintained by a system of general taxation, or the State in some instances grants a franchise to a company for the construction and maintenance of turnpikes at a certain rate of toll for the traffic passing over them. In others the State requires its able bodied citizens between certain ages, to work so many days each year on the roads, under the direction of road precinct overseers appointed by the county courts with the alternative of one dollar a day fine for non-attendance; this is undoubtedly a most crude and unjust law, as through some means the residents of cities and towns seem to be exempt from its operations, the burden falling on the poor man who cannot afford one dollar a day for a substitute, and has to leave his farm to work the road with his neighbors so that they be kept in repair for whoever may desire to ride over them.

That this law is practically worthless and inoperative cannot be wondered at as it is considered one-sided and unjust by those who come under its provisions, who after assembling at the call of the overseer with a few old rusty axes and hoes lay them (the

axes and hoes) carefully aside and choosing a shady place devote themselves to the intellectual occupation of playing poker or seven-up, varied occasionally on the way home by putting a few pieces of brush into a gully or filling up a few bad wheel ruts by scratching with their hoes. The result of all this is of course no roads worthy of the name.

The remedy for this state of affairs and the proper manner of arranging for the construction and maintenance of our public roads, would appear to the writer to be by a system of general taxation falling equally on rich and poor alike, on the resident of the city and of the country and on the property of the non-resident property holder, supplemented when practicable by the labor of State and county convicts. That this would be equitable all round would appear to be beyond dispute, as each town is interested in drawing to it the trade and produce of the surrounding country, which must have roads for its accommodation, the better and more roads in a country the more valuable are the adjacent lands, hence the advantage to the property holder, the better and more roads, the better for the farmer and producer as it costs him less to market his produce, for what shall it profit a man to raise 25 bales of cotton or 200 bushels of corn, if he has to borrow all the oxen in his neighborhood to haul it to market; besides the broad principle is involved that the roads are public highways, the property of the State, over which all its citizens have the right to travel, consequently all should be equitably taxed for their maintenance.

The next subject that presents itself for consideration in this direction is the manner in which roads should be located or changed or the manner of their construction and maintenance. Owing to the system of United States land surveys prevailing in the older States, the question of location is a comparatively simple matter, but is altogether different in Texas, as the old Spanish system of locating tracts of various sizes and in any shape where vacant land existed, prevailed, until the public domain was exhausted, no reference being had to Township or other regular lines, hence the location and changing of county roads has been a source of unending trouble and vexation to county courts and citizens generally, and seems to be growing worse as population increases and land enhances in value.

Laws have repeatedly been passed regarding this matter, but so far without being satisfactory.

With regard to the general system that should be adopted, the subject is such a difficult one, and has had so many laws passed regarding it in various States and so much thought and discus-

sion bestowed upon it that the writer is free to admit that he approaches it with diffidence, but as the art of road-making lies properly within the sphere of the engineering profession, the question of the best system to adopt with regard to the formulation of laws governing the subject in its entirety is a proper subject for consideration and discussion by this Society, so that the knowledge and experience of the membership throughout the different States may be elicited by the discussion of this, and by supplemental papers on the subject, with a view to arriving at a definite decision on the subject for the possible future guidance of those whose province it may be to make laws on this very important subject.

To begin with, the general laws governing the subject should emanate from the State and be binding on the counties or road communities, and to be effective should begin at the beginning, or start from the foundation of the subject.

In the sparsely settled States of the South where the majority of the counties or parishes are not yet wealthy enough to employ a skilled engineer to lay off and direct the construction of their highways, it would seem to the writer to be the duty of the State through its State engineer and his assistants to undertake the matter and make a beginning by laying off and constructing say one important main highway across the length or breadth of the State, taking in such important towns and county seats as lay in its way, the line to be properly located by instrumental surveys as on railroad work, the right of way for the road to be paid for and the line to be laid on the best ground with a view to economy of construction and future maintenance as a highway for all time, regardless of any local considerations; the entire work to be laid off and cross-sectioned as on railroad construction, *under the general direction of the State Engineer and the immediate direction of his assistants as resident engineers of the works, and the work to be executed by convict labor furnished by the State* with the exception of the teams and drivers which could be furnished by each county, and which they could furnish at light expense and be glad of the opportunity of getting a thoroughly constructed road so cheaply.

A road constructed in this manner would, from the nature of the case, be comparatively inexpensive, and would be such a highway as no county could individually build by itself; and being executed under the direction and from the plans of a skilled engineer, would, with the necessary incidental repairs from the various counties through which it passed, be a highway for all time to come.

The economical construction of such a road in a thoroughly

first-class manner would call for considerable skill and ingenuity on the part of the engineer, as he would have to rely on his own resources and utilize the materials at hand all the way through. A road of such extent would necessarily pass through a great variety of soils, from the rocky, gravelly ridge to the swampy, alluvial bottoms, in either of which the engineer need not be at a loss for the materials out of which to construct a good road. In the former case, of course, the material itself would furnish the necessary foundation and road metal; in the latter this would have to be made artificially or hauled from a distance.

The prime requisites for such a road are *drainage, foundation* of the roadway and *ballast or road metal*, together with ample provision to allow of the beneficial action of the sun and wind. A width of twenty-five feet available roadway would be ample where entirely ballasted; in addition to which in excavation would be the width of ditches, and in embankment the width of ditches and berms, which latter should be not less than five feet, the grades being laid so as to establish effective drainage to the nearest opening with culverts of wood or stone to pass the water from the up-hill ditches when possible; the roadway for this width to be crowned from three to four inches; the theoretical determining of the size of the openings will not here be entered into further than to say in passing (speaking figuratively), they cannot be made too large. The maximum gradient for such a road may be set down at 1 in 20, which there should be no difficulty in obtaining, ordinarily, with a good location, and, if necessary, taking some heavy work in exceptional cases where required; the gradients as a rule would be found to run considerably under this.

The angle of repose, according to Mahan, is for various roads as follows:

Broken stone surface on concrete pavement.....	1 in 49
“ “ “ “ rough “	1 in 49
“ “ “ “ old flint roadway.....	1 in 35
Gravel roadway.....	1 in 15

He further says: “The steepest gradient that can be allowed on roads with a broken stone covering is about 1 in 20, as this from experience is found to be the angle of repose upon roads of this character in the state in which they are usually kept. Upon a road with this inclination, a horse can draw at a walk his usual load for a level without requiring the assistance of an extra horse; and experience has further shown that a horse at the usual walking pace will attain, with less apparent fatigue, the summit of a gradient of 1 in 20 in nearly the same time that he would require to reach the same point on a trot over a

gradient of 1 in 33." The side slopes in excavation and embankment are liable to vary with the nature of the soil; 1 to 1 in excavation and $1\frac{1}{2}$ to 1 in embankment will be found to cover the majority of cases; modifications of these slopes would, of course, be necessary in special cases to suit peculiarities of material, the writer's experience being that steep side slopes answer best in excavation, except in special cases, which rarely occur. The prevention of outside surface water from reaching the roadway in excavation is of importance. This can be guarded against by surface ditches along the edge of the cuts, and by wasting enough excavated material on the up-hill side to act as a dam for this purpose. In the construction of the roadway proper, the use of a heavy road roller will be found indispensable, both in the preparation of the form or foundation and in the compacting of the road metal or ballast. Much difference of opinion still exists as to the relative merits of the Telford and McAdam systems of pavement. Possibly, where the foundation is imperfect, the Telford plan of placing a layer of flat spalls on the form before laying the gravel or broken stone is the better, although a layer of four inches of clean sand similarly applied would, in the writer's judgment, be equally as effective. He has knowledge of several excellent pavements formed of twelve inches of clean sand and gravel laid on a form properly rolled to receive it, the material also being rolled in layers as 'twas laid, which has given excellent results under heavy traffic. The requisites would, therefore, seem to have narrowed down to a stable form or foundation thoroughly compacted by rolling, and a sufficient depth (not less than twelve inches) of good ballast, thoroughly rolled when being laid. In this connection it is well to remember that an important duty of the road covering is to prevent water getting to the foundation of the road. In the construction of a road through swampy bottom lands, which at first sight would appear to be almost impossible, it is in reality not difficult when properly undertaken. A prime requisite for a road in such a location would be ample width of right of way, clearing (not less than 200 feet) to allow of the free action of the sun and wind; equally important would be the foundation and the raising of the road-bed above the general level of the bottom.

In Holland the foundation for such roads is made by using one or two layers of facines preparatory to placing the material of the roadway proper. In the special case under consideration the writer would suggest the utilization of the material cut from the right of way by placing medium-sized limbs and branches transversely across the road for its entire width in the form of cor-

duroy, and filling up the interstices with smaller branches and covering the whole with a layer of about six inches of brush, upon which the excavation from the side ditches (which latter should be ample in size) should be distributed and rolled in layers until a depth of eighteen inches had been put in place, and finished to the proper grade, properly crowned, etc; upon this graded roadway a sufficient number of small charcoal kilns to be built and fired, the charcoal to be distributed and rolled as a final covering or road metal, with a light top dressing of sand or gravel. This should place the roadway some three or four feet above the general level, and with ample drainage and width of right of way clearing, and a good road metal, should make an excellent road, easy of maintenance.

With regard to the culverts and bridges for such a road, much of the material in the shape of stone and lumber could be found in the neighborhood of the work and utilized, and would in any case be comparatively inexpensive in most of the Southern States, where such a wealth of good timber abounds.

The system here outlined may be considered by some to be too radical a departure from the present methods, or it may be urged that such work would entail expense. Of course it will. Roads will not grow up spontaneously throughout a country, and if we propose to have any we must build them. The expense, however, under this arrangement, would be light, and no better disposition could be made of the small portion of our revenues that would be necessary to the construction of such suitable highways to facilitate the development of the agricultural and manufacturing interests of the country, upon both of which, almost exclusively, the prosperity of this section depends.

It is believed, however, that upon mature consideration, the plan advanced will be found entirely feasible, and with many features to recommend it, especially when it is considered that the various plans heretofore tried have failed to give us roads worthy of the name, and that it is freely admitted on all sides that something should be done towards a practical solution of this heretofore unsolved problem.

That something should be done is freely admitted, and that the various counties of themselves, for self-evident reasons, are not equal to the task, is also admitted. It would, therefore, appear that the duty devolves on the State, which has both the power and financial ability for the undertaking.

The utilization of convict labor in this manner would tend towards a solution of that vexed question, as the placing them on such a public work would be utilizing their labor on an important and much-needed improvement, without coming in com-

petition with free labor. Besides, the economy of the system would allow such roads being built at the minimum of cost.

Another point of view from which to consider this matter is that every such road would be a public educator to a certain extent, as the road overseers and citizens generally of the various counties would have a practical example of the construction of a thoroughly built highway, which knowledge would be utilized by them in the construction and maintenance of their roads generally.

Favorite localities for the building of such roads across the length or breadth of the various States will no doubt readily present themselves in each case. In Texas we have the remains of an old Spanish road the *Camino del Rey* which formerly extended between San Antonio in the southwest and Nacogdoches in the northeast, two of the earliest settlements of the country, and about 300 miles apart, which would answer admirably for the purpose, portions of the road are still in use, and it is recognized as the boundary line between several of the counties. The writer has come across portions of it at different times while engaged on professional duties, and takes pleasure in testifying to the skill of its early locators. Such a road could be rapidly and economically constructed under the system as above outlined, and it is believed that upon its completion, the advantages would be so manifest that the system would be still farther extended. The plan here outlined contemplates the maintenance of these roads by the various counties through which they passed, either by contract at so much per mile or by the labor of county convicts as would be found most advantageous.

MICHAEL L. LYNCH.

Temple, Texas, Aug. 26, 1886.

A discussion of the paper followed:

Mr. J. W. Sacket—"In the paper just read the author recommends putting only eighteen inches of earth over the corduroy and facines in low, wet places. I think this would be too little."

Mr. R. N. Ellis—"I suppose that is the minimum, where the poles and facines are well and compactly laid that would do."

Mr. J. F. LeBaron—"I think the plan Mr. Lynch has outlined is very good. We need better roads and more of them. We have in Florida several roads of this character, the old Kings and Military roads, some of which are 300 years old and they are the best roads to-day in the State. They were evidently laid out by an engineer and by instrumental surveys, and well and thoroughly built."

Mr. M. C. Kollock—"Yes the Kings road that runs from Jacksonville to Savannah was very carefully located and well

A Very Successful and Reliable Institution.

The attention of our readers is directed to the advertisement of Messrs. Cornish & Co., which appears on another page.

It is a fact that the Cornish Organ and Piano Co., at Washington, New Jersey, are actually running their factory both day and night in order to promptly supply the enormous demand made for the celebrated Cornish Organs and Pianos. Have you read their beautiful new Illustrated Catalogue yet? If not, send to-day for it. They are entirely responsible financially, and enjoy an enviable reputation in all parts of the civilized world. Read their advertisement. Address, Cornish & Co., Washington, N. J.

FAUTH & CO.,

MANUFACTURERS OF

ASTRONOMICAL AND ENGINEERING INSTRUMENTS WASHINGTON, D. C.

We draw especial attention to our Improved Engineering Transit, with the best and simplest Solar Attachment and quick Leveling Tripod yet invented. See for Catalogue.

Cor. 2d St. and Maryland Ave., Washington, D. C.

The following extract from a letter explains itself:

WASHINGTON UNIVERSITY, St. Louis, Mo., October 20, '84.

Messrs. Fauth & Co., Washington, D. C.

DEAR SIRS—I am more than pleased with the Solar Attachment you put upon my Transit last spring. I regard it as at once the cheapest and by far the best attachment in the market. It is readily adjusted and manipulated, is wholly out of the way in using the transit, and is accurate beyond any disk attachment. * * * I think you have solved the attachment problem.

Very truly yours,

J. B. JOHNSON,
Professor of Civil Engineering.

To Investors and Intending Settlers.

GOVERNMENT LANDS IN FLORIDA,

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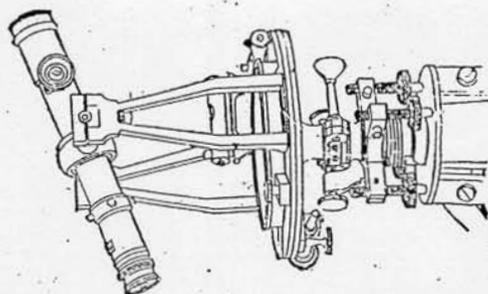
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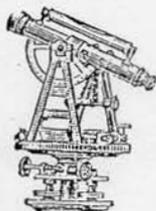
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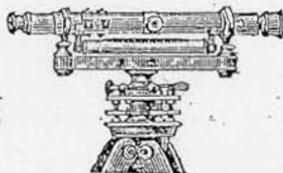
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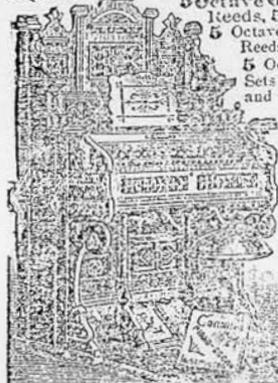
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