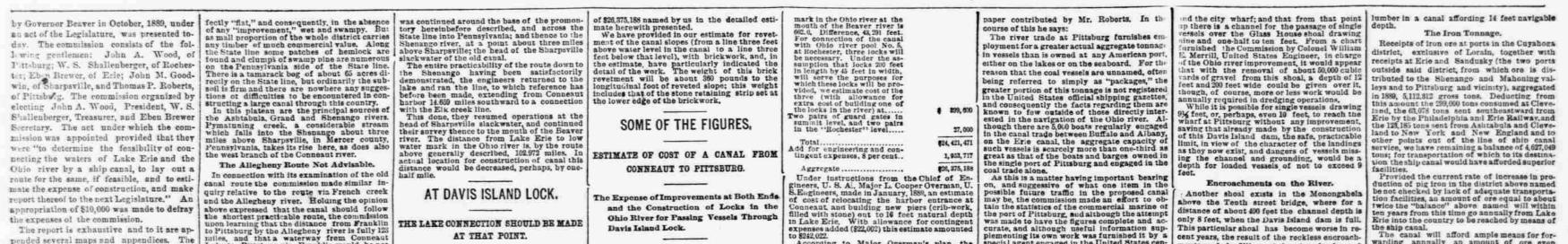
	,		PITTSBURG, SATURDAY,	FEBRUARY 21, 1891.			1
ITS FEASIBILITY SHOWN. Boute Decided Upon From Conneaut Lake to the Ohio Biver. SOME VERY CONVINCING FIGURES. The Canal as a Trade Developer for the Great Northwest. WILL BE A GREAT THING FOR THIS CITY Members of the Commission Submit Inter- esting Papers Upon Special Features of the Proposed Work—The Cheapness and Reliability of Water Transportation as Compared With That by Bail—The Hap- bors of Pittsburg and Erie, Their Com- mercial Importance and What the Canal WIII Do for Them—Davis Island Lock as an Outlet. MERCIAL TELEGRAM TO THE DISPATCH. 1	acting, are: the greatest possible degree of general utility of the canal in direction of enlargement and general betterment of means for transportation, and facilitation and promotion of commerce between the principal coal producing and iron manufacturing region of the country and the great and rapidly developing Northwest; and large serviceableness as a means of prompt delivery into the lakes of armed vessels, should need for such means for protecting our lake cities unhappily arise. The Secretary of War in his latest annual report calls attention to the fact that the smallest of the SL Lawrence canals are capable of passing armed vessels of a class of which there are more than 50 in the British navy; and that within a short time none of the Canadian canals will have less than 15 feet of water on its lock sills; with which condition more than 160 of the vessels now in the British navy might pass into the lakes. Under the treaty, between Great Britain and the United States, now in force, neither country may build nor maintain may vessels on the lakes; but the country that has ample means for promptly putting armed ships into these waters does not need to build them there. No Outside Considerations. The canal herein recommended would pass public so as to afford service as great as may be by any means derived from such a work, the commission has, from the beginning, feit that no considerations of the construction of the real on this or that route), of any locality, nor section of country should have any weight as against the selection of that route, which, without opposing to the construction of the canal unduly great obstacles, affords the waterway a curse shorter thae, and otherwise fully as favorable as, any other.	the Shenango and Mahoning rivers, with a scanal occupying the Warren route. The distance from Sharpsville to said point of confluences is about 20 miles. In view of the facts above stated, the commission adjudged the Warren route unavailable. Terminal Facilities at Erie. The commission early took into consideration the natural advantages and commercial importance of the harbor of Erie as a terminus for the canal. There are two, and probably three, other approaches to the bay from the long level in which such a canal would extend from Girard to the city limits of Erie, any one of which would afford better facilities for construction and operation than would the old line, even if that line were free from obstacles. These approaches to the bay are formed by water courses, heading from a mile to a mile and a half south of the shore, at the level and nearly on the line which the projected canal would, if constructed, occupy, and falling into the bay at points where abundance of unoccupied shore line within practicable reach of large areas of deep water would permit the location of an entrance basin entirely safe, convenient and adequate to the demands of the state secure. These superiod after taking all things into most deviation, concludes that Erie harbor is simple because the canal would be fully 22 miles longer than it wild be fully 22 miles longer than it wild be fully 22 miles longer than the to construction of a deep harbor at that the conditions generally were not favorable to construction of a deep harbor at that after influent for service in convection with a ship canal, is not reasonably practicable; and, moreover, the Elk creek foute is 7½ miles longer than that to Conneant harbor. In view of the ship canal, is not reasonably practicable; and, moreover, the Elk creek not harbor. In view of the stars the commission abord one det is dea of taking the commission ison and when the combines in the comment of a composed at the complexity of the ship canal would be indicated, establishment at Elk precek of a ha	Some of the Principal Work. The principal pleces of work to be executed in construction of our canal are: The cutting inst north of the crossing of Conneaut river; the aqueduct at the crossing of Conneaut river; the aqueduct at the crossing of Big run, and the cutting next south from the last named aqueduct. The cutting first named makes something more than 1,000,000 cubic yards of excavation, about one-haif of which will pre- sunably go into the aqueduct embankment adjuent to be handled in construction of the canal proper, in this length of the work, is amount only 39 per cent greater than that estimated as going to construction of like area of normal prime of the canal. The plan for construction of the aqueduct, there crossed, through the point of the shale- cilif, on the north side of the stream, by means of a double tunnel way, each opening being 40 foot thereof, contemplates carrying the stream, brick work: internediate pier of stonema- brick work: internediate pier of stonema- to stude serves, also, to pass under the aque- tons which serves, also, to pass under the aque- tons which serves also, to pass under the aque- tons the north side of the stream, by means of a double tunnel way, each opening being 40 brick work: internediate pier of stonema- brid, on the north side of the stream, by means of a double tunnel way, each opening being 40 brick work: internediate pier of stonema- brid, the serves, also, to pass under the aque- tons mankment the tail-race of a water so the stream, we provide a ten-foot arched cu- brick serves, also, to pass under the aque- tons and constructions' plant generally, in machinery, and contractors' plant generally, in machinery, and contractors' plant generally, in anchinery, and contractors' plant generally, in anchinery, and contractors of large ex- prisence in work of the several sorts involved. 	P-tool water: delivery at ve- locity of 85 feet per minute, 1.20.200 cubic feet per hour. May 33 miles of feeder at aver- age of 32,000 cubic yards paid material, per mile at 24 cents per cubic yard. 20,000 Pipe conduit - 36-inch from pipe, 74 pounds per foot, at 19 cents per pound delivered, equals per mile. 24,654 00 Lead joints. 79% ibs per joint. 1,200 200 Trench. %4 feet x 6 feet; 8,225 907 80 Cobic vards at 300. 907 80 Labor, laying. 450 90 Cobic vards at 300. 97 80 Labor, laying. 450 90 Cobic vards at 300. 97 80 Labor, laying. 450 90 Cobic vards at 300. 97 80 Cobic vards at 300. 97, 500 So cotners, big and little 135, 600 Night of way - Conneaut to Subenango river, 52 miles (in- cluding distance from lake to lock No 1), at 38% acres per mile, 1, 385 acres at \$20. 14, 560 730 acres at \$30. 15, 600 15, 600 Damages along Shenango and Beaver rivers 98, 460 Damages along Shenango and Beaver rivers 155, 000 Right of way for feeders: 255 acres at \$20 per acre. 530 Sto of storage reservoirs a n d necesary marginal space, say 17, 200 acres, at av. 530 Rig	no way involved with the considerations regarding a water supply. Mr. Roberts thinks that dams in the Allegheny should be constructed with special reference to resist the action of ice in the river. His idea was dams of ten feet lift and designed to afford a depth of nine feet for the passage of boats, making to the comb of the dam a height of 19 feet from the bed of the river. He regards this height for a permanent structure as excessive, and thinks it would be advisable to arrange on them a system of adjustable shutters of plate iron or steel, raising, or rather lowering the height five feet whan deemed advisable. When the shutters would be low down they would present a smooth, metallio top on the creat of the dam for the passage of ice, and when down the dam would be only 14 feet high. Most of the dams above Freeport can be founded on solid rock, which remark applies to the locks as well. Flood Lines of the dam would be only 14 feet high. Most of the Allegheny. The highest flood record at Pittaburg is a rise of 84 feet 4 inches. At Oil City, about eight miles above the mouth of French creek, the highest stage recorded in the Allegheny y the United States Signal Observer stationed at that point, since 1877, which is as far back as complete records are obtainable, is 18 feet, which flood occurred February 4, 1883. The interference to navigation upon the whole river by reason of floods, in case this river is slack-watered, will not be found to be a serious difficulty on the Monongahela, where the floods are much higher.	to the right bank of the river. Next to the main shore is the lock, 600 feet long between gates, and 110 feet wide, making the largest lift lock, so far as area is concerned, in the coun- try. The dam is peculiar in construction from the fact that it is arranged to be lowered in verides of freshets or rises, which are the only times the coal barges and boats, which draw from 6 to 8% feet of water, can navigate the river bo- low. The periods of freshets are very irregu- lar in their occurrence and duration, and while waiting for them it was very important and es- sential that a safe harbor of good depth should be offered, in which the boats could lie without injury or liability of grounding. Upon the oc- currence of a natural stage of water, making a depth below the dam in the channel of the Ohio of 7 or more feet, it is lowered and the coal-towing steamers, with their fleets, pass out through the "navigable pass" of the dam, and, of course, without going through the block. Upon the return of the steamers bring ing back empty boats from points below it may occur that the river at Pittsburg has failen to 4 or 5 feet natural depth, in which case the Davis Island dam will be found raised, and in which event the boats must necessarily be passed through the lock to reach the pool of the harbor about Pittsburg, the idea of this dam being to maintain, as permanently as pos- sible and form depth in the harbor. Improvements of the Harbor. Without knowledge to be acquired from thorough hydrographic survers of the entrre inverbetween the Davis Island dam and Pitts- burg, the Commission would not be warranted in suggesting detailed plans looking to the im- provement of the harbor of thatigity, and mak- ing it more entirely available for vessels draw.	mitted) on its lock-sills. And under operat of conditions to be induced by establishm of the canal, steamers now loading to a dram of, very nearly if not quite, 16 feet, in order handle a cargo of 2,306@2,400 gross tons, v find a trade involving the round trip throu the canal inotwithstanding the limitation to feet draught), more lucrative than that which they have been heretofors engaged. Cleveland receives by lake large quantil of lumber, distribution of which, to the co- try south and southeast from Cleveland is mu- by rail. Receipts of lumber at the port question in 1889, aggregated 333,000,000 feet M. For vessels suited to this trade, the ca- will afford ample water. The Wahnipitae (recently stranded in totally lost), schooner-rigged, but ordinal operated as a tow barge, was 250 feet in len (customs measurement), and of the extrad- inary beam of 51 feet. With no more than feet of depth shie could carry about 1,000 feet B. M. of lumber. Her net tonnage
- CONNEAUT HARADOR	urnauta Reservous cock ap tock ap tock ap	Loer 25 32. 36. 1000	Cross Franking By Const Franking Const Print Research Const NY Pao MP Const NY Pao MP Const NY Pao MP Const NY Pao MP	CA OF SUMMERAL	13 Bridets 33 & 40 Bridets 40 WATE Bridet New Charter	HAN A POLL ANIMATING ANALAS	nn Bribes Beaven Frizs. Beaven Frizs. Car Bruarson Car Bruarson Leves Posser From 25 44400 Leves Posser From 25 44400 Love R. Abortes Fre

OCK 35 TOTAL LOCKAGE UP FROM LAKE. 443.11 FT. DOWN, TO ROCHESTER LEVEL, 310.709 FT. PROFILE OF LAKE ERIE & OHIO RIVER SHIP CANAL FROM CONNERUT HARBOR TO THE OHIO RIVER AT ROCHESTER_ MILLS-.90 100

NUEN S NUEN S Pass Fock

NCH 30

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10.35 MS

the expenses of the commission

of dimensions and capacity generative connect the 199% miles. Burate to the term ship canal to connect the International The Size of the Canal. some available route, fessible, the commission made this subject of inquiry its first study.

The history of the canal known variously as The history of the canal known variously as the "Erie canal of Pennsylvania" and as the "Erie actension canal" shows that the surface of the water in the summit level of that canal was at the elevation of 1,0825 feet above mean occan level -equivalent to elevation of 509.61 feet above the mean level of Lake Erie-and that the area of country in the neighborhood of the canal, and lying higher than 1,6825 teer, is entire y insufficient for supply of water in quantity adequate to the service of such sum-mit level, even with a catal of no more than t level, even with a canal of no more than or feet depth of water and 44 feet width of water surface The entire water supply of the summit level

(except an amount estimated by the engineer of the old canal to have been "at the least" equal to 975 cubic feet per minute, or 1,404,000 cubi eet per diem, "throughout the year," which amount this commission, on basis of gauge made in July, 1890, estimates at 1,512,000 cubic feet per diem), was drawn from a reservoir at "Hennus' Dam" on French creek, about three mules above Meadville, by a feeder (which was I navigable size) some 27 miles in length.

Because of the elevation of the canal, relaive to that of the country through which it lay, no water supply other than that just named was practically available anywhere between the summit and Erie harbor, distant 44% miles was practically available anywhere between the summit and Erie harbor, distant 445 miles from the point af which the French creek sup-ply entered the canal; nor within the 165 miles next southward from that point. Consequently the service of 61 miles of canal north of a point 165 miles south from the southern end of the summit level, depended entirely upon water supplied by French creek and Gonneaut Lake.

Feasible but Not Practicable.

By the construction of several reservoirs and a conduit of no great length an addition to this supply of all the waters of Watson's run (see general map) might have been made; and by means of a feeder of some 24 miles in length ntilization of some of the headwaters of the Shenaugo was feasible, but hardly reasonably

Shenadigo was reaction, but dariny reasonably practicable. Having fully considered all the facts bearing on the matter, among which is the important fact that the volume of water in any given length of a ship canal, such as that construc-tion of which is herein recommended, will be something more than 13 times that in a like length of the old canal; and the other facts that any wholesale diversion of the watersof a large stream, such as would be necessary to the service of a canal very much larger than was ice of a canal very much larger than was the old canal, to be maintained on theold canal route, would be inequitable; and a project in-wolving such diversion indefensible; the com-mission concluded that maintenance of a ship canal on the route of the old canal is not praticalde. It has to say, however, that this route, which it adjudges "impracticable," is better than any other lying wholly in Penn-

Bylvaula.

An Immense Plateau.

Conneaut Lake lies in a considerable depression in the range of highlands forming the "divide" between the waters flowing into Lake Eric and those of the Shenango Valley. The elevation of the crest of this range is every-

elevation of the crest of this range is every-where east, or northeast, from Councaut Lake, greater than at the point where the old canai frozenes it. Where the Erie and Pittsburg Railroad crosses the range in question at a point some miles west from the longitude of tagher than the water surface line in the old canal summit level. And generally, going west from the lake, we find the crest of the range about 80 feet higher that that water line, until, almost immediately west of the boundary line between Pennsyl-vanias and Ohio, the range quite abruptly ter-promotory into a sta, into a great plateau her for the bounded of the summit promotory, and some 605 feet below the summit level water surface of the old canal.

the expenses of the commission. The report is exhaustive and to it are ap-pended several maps and appendices. The commission say that the specifications of the resolution under which it was created are not entirely explicit. The commission, the report says, his acted upon the assumption that the omission from the resolution of there is the field of inquiry was in-tentional, and not merely an inadvertence. How the Land Lays. The question 'of feasibility in this, as in any fike case, is marely relative. In order that it marks, before proceeding to actual surveys, satisfy itself that the establishment of a canal of dimensions and capacity generally commen-surate to the term ship canal to connect the upon learning that the distance from Franklin

about midway of the length of Brunot's Having reached the conclusion that the canal must follow a route taking it through the above described plateau in Ohio, the commission sought data for determining the depth of water, dimensions of waterway and size of water, dimensions of waterway and size of locks necessary or desirable in the contem-plated canal. Having been warned that vessels now engaged in freighting ore and coal on the lakes are of size much greater than that formerly considered sufficient; and that a canal, in order to accommodate the ore car-riers of to-day, must have navigable depth of at least 16 feet; and that, moreover, no ore freighter nor coal carrier in use in present prac-tice could afford to waste time in a canal; the commission approached this subject with some must vessel.

vings. vas, however, reassured upon ascertaining It was, however, reassured upon ascertaining in the average cargo of ore received at the Lake Shore and Michigan Southern Railway docks at Ashtabula (the principal ore-receiv-ing port of Lake Erie) in 1889, weighed out 1,494.14 gross tons; which average compared with that of Escanaba cargoes (averaging considerably higher than cargoes from Lake Superior) in 1873, shows increase of no more than 202 tons (per average cargo) in the period of 16 years milicated by the dates given. It learned that the average coal cargo shipped from the Lake Shore docks at Ashta-bula in 1859 weighed in 1,2064 net tons; the number of cargoes having been 206, carried by 189 several vessels of which 105 came to Ashta-bula with ore. It learned further that of 166 vessels bringing ore to Ashtabula in 1889, 120 brought less than 1,500 gross tons at a trip; and that of 104 vessels taking coal from that port in said year, 79, or 75.76 plus per cent of the ves-sels engaged in carrying ore and coal on the lake can pass, loaded to their full capacity, through a canal affording 14 feet navigable depth of wate.

depth of water. In view of these facts and others going to show that even the largest vessels navigating the lakes may profitably use a canal between Lake Erie and Pittsburg affording 14 feet havingable depth, and after due consideration of the natural conditions in the Shenango, Beaver and Ohio rivers, respectively, to which canal construction must, or will preferably, conform, the commission recommends that the canal be made to afford 14 feet navigation (to do which it will necessarily correct here to fact of mich made to allord is feet navigation (to do which i will necessarily carry at least 15 feet of water on lock sills and elsewhere) being satisfied that establishment of that capacity is readily practi-cable, and being of opinion that a canal having that capacity, with locks large enemch to pass a vessel of 330 feet in length and 44 feet beam, will adequately satisfy all demands of the com-merce for accommodation and development of which it is designed.

The Conneant-Shenango Route.

A ship canal on the Conneaut-Shenai route will not divert from their natural courses

any waters tributary to any stream rising in Ohio; and certainly would not in any way in-terfere with that canalization of the Mahoning

terfere with that canalization of the Mahoning tiver, which, as this commission assumes, would, simultaneously with the construction of the canal from Lake Erie to the Ohio river, be effected for the purpose of bringing the Lower Mahoning Valley, with its 15 blast furnaces, 10 rolling mills, and very many other manun facturing establishments, into the ship canal system. The natural waters of the Mahoning are, under suifable management, amply suf-ficent for maintenace of such lateral ship the Shenaugo Valley line just below the point at which the Mahoning and Shenango join to form the Beaver river. The canal on the Conneaut-Shenango route will serve the valley of the Shenango route will serve the valley of the Shenango route at blast furnaces, 9 rolling mills (exclusive of 21 blast furnaces, 9 rolling mills (exclusive of 22 blast furnaces, 9 rolling mills (exclusive of 23 blast furnaces, 9 rolling mills (exclusive of 24 blast furnaces, 9 rolling mills (exclusive of 25 blast furnaces, 9 rolling mills (exclusive of 26 canal system, which weak of the Shenango route with serve the valley of the Shenango route with serve the valley of the Shenango route 24 blast furnaces, 9 rolling mills (exclusive of 25 blast furnaces, 9 rolling mills (exclusive of 26 canal system, which weak of the Shenango route 27 blast furnaces, 9 rolling mills (exclusive of 28 canal the shenange route canal from Portsmouth to Cleve-18 canal the canal system, which weak of the shenange route canal system, which weak of the shenange route canal the shenange route canal the shenange route canal system, which weak of the canal system, which weak of the canal system, which river, which, as this commission assumes, would, simultaneously with the construction of the canal from Lake Erie to the Ohio river, be effected for the purpose of bringing the Lower Mahoning Valley, with its 15 blast furnaces, 10 rolling mills, and very many other manu-facturing establishments, into the ship canal system. The natural waters of the Mahoning are, under suitable management, amply sui-ficent for maintenance of such lateral ship canal system, which would make junction with the Shenango Valley line just below the point at which the Mahoning and Shenango join to form the Beaver river. The canal on the Conneant-Shenango route will serve the valley of the Shenango, with its 21 blast furnaces, 9 rolling mills (exclusive of the 5 rolling mills of the Beaver Valley), steel works, nail factories and many other manufact-uring establishments, by means of water

It is founded and any out, as a promotion of the shore and any other manufact any other man

THE LAKE CONNECTION SHOULD BE MADE AT THAT POINT.

> Its Location There of Great Importance to the Commerce of Pittsburg-The Feasibility of Building the Canal to the Lock Demonstrated.

harbor:

Dredging (and removal of ma-

terial) at Conneaut Harbor to make basin (including pres-

ent river bed) of 93-1 - acres,

feet (see map)..... One mile of bulkhead (or

Excavation and embankment

neet masonry arch culvert, under embankment...... oncrete in chaunel-way in

Two arches under Big Run

nango creek. Masoury in culverts, for pas-sage of small creeks and rons. 280,000 cubic yards masoury

Plank in aqueduct

wharfing), pilework, f 16 feet wide, with 3-inch

plank.....

with depth throughout of 17

A canal constructed on the line described would "connect the waters of Lake Eric with the Ohio river," but the commission is clearly of opinion that the connection of the lake with the river should be made at Davis Island lock. The fact that Pittsburg harbor, from Davis Island dam up to

Island, a distance of about two miles, may, at insignificant cost, be made navigable by vessels drawing 14 feet, is fully shown in the paper on the characteristics of the Upper Ohio. accompanying this report. That in order to pass a vessel drawing 14 feet of water from the terminal lock of the ship canal through the Davis Island lock no alteration nor deepening of that lock would be necessary, is made evident by the diagrams and accompanying specifications herewith submitted. For passage of river craft from the Ohio into

Elevation of Surface - 1016.0

the canal, or vice versa, at the mouth of the Beaver, locks appropriate to such interchange should be provided, and an item representing the cost of such locks is included in our esti-

the cost of such locks is included in our esti-mate. Delivering its boats into the Ohlo river at the mouth of the Beaver river, about 25 miles below Pittsburg, the old canal was of but small serv-ice to commerce between Pittsburg and the lake; whereas, had it been extended, according to the original plan to Pittsburg it would have fostered traffic, and grown to meet the growing demands of that traffic so that it would have long ago attained the dimensions of a ship causi instead of suffering entire annihilation at the hands of the railways as It did.

Its Feasibility Is Shown. Satisfied, as it was, that the Ship Canal ter-

minating anywhere below Pittsburg harbor would fall as far short of possible usefulness as did the old canal, the commission took the steps necessary to satisfy itself of the feasibility of constructing the canal not merely to Rochester, but to Davis Island lock. It here-Rochester, but to Davis Island lock. It here-with presents a map, made from its surveys, of the right bank of the Ohio river from Davis Island dam to Rochester, also a map showing the proposed location of the canal through Rochester; but it has not undertaken to deflue upon the first named map the exact line prefer-sbly to be followed in constructing the canal. The prime object in making this map was to show that for the greater part of the distance between Rochester and Davis Island dam there is ample space between the river bank and the railway; and that a canal may be construct-ed along the river without interference any-where with any important structures, and with-out any objectionable encroachment upon the waterway of the Ohio river. That in the 20 miles of its course lying next below the mouth of Beaver river the Ohio river approaches Lake Ette more closely than else-where, is a fact entirely obvious to any person who examines a proper map showing the States of Pennsylvania and Ohio. **A Practical Canal Summit.**

A Practical Canal Summit.

The fact that the surface of the country lying

sage of small creeks and runs, 380,000 cuble yards masonry in river walls in Beaver and Ohlo rivers respectively, @ average price of \$ per cuble yard... Masonry for water-ways under canal, between Hochester and Davis Island dam... Revetment of canal slopes (see comparison of weight and cost of brick, stone and plank respectively, in body of re-port.) respectively, in body of re-port.) Brick revoluent - Brick (Sid inches X4 inches X25 inches) iaid on edge, with Joints 5 inch: with retaining stone 4 inches thick X12 inches deep, set at lower edge of brick work; the whole to ex-tend from line 3 feet below water level; covering 12 feet on face of slope; sli laid in cement; 1 cuble yard of se-ment mortar (cement 1, sand 2), for each 340 brick (i cuble yard for each 20 feet in length of canal. One cuble yard of canal. between Lake Erie and the Ohio river has a general declination westward, suggests the existence in any stretch of country along the divide, of 20 miles or thereabout in extent, lying

while there are on the Conneautroute several . 245, 352 ft

of Fegulaing sereiment be

100 C

Davis Island Lock. Appended to the report are the following estimates of the cost of constructing the canal from Conneaut harbor to Pittsburg

\$250,000

\$8,080

43, 282, 475

\$105, 404

34,755 4,028

to \$242,022 According to Major Overman's plan, the channel way would be 160 feet wide, between piers, dredged to give 15 feet depth of water from the lake to inshore end of the works. Enlargement of this plan so as to give 17 feet of water at inner end of channel way, and to carry the piers out to 15 feet natural depth. In the lake, would entail additional cost of per-haps \$80,090, making whole cost of the new har-bor entrance say \$322,000.

THE SUPPLY OF WATER.

STORAGE RESERVOIRS AND THE QUAN-\$318,050 TITY IN FRENCH CREEK.

> How Much Can Be Depended Upon From Both Sources-Drainage Capacity of the

> Water Shed That Will Supply the Needs of the Ship Canal. J. M. Goodwin submits some figures, show

ing the capacity of reservoirs for supply of Summit level. He shows that the nine reser-\$5, 656, 495 voirs will hold an aggregate of 2,264,412,360 cubic feet, while the seven reservoirs below the summit will deliver 2 239,088,960 cubic feet. 7,853 434 90,000 or a grand total of 4,503,501,320. The season of navigation being 214 days, the average daily supply to Summit level is 10,581,365 cubic feet from storage alone. The total acreage of tributary surfaces is 79,235, or about 124 square miles. The probable aggregate area of land to be acquired for reservoir purposes is 14,357 acres, of which a large proportion is now, prace 296,000

110,000 tically, waste land. T. P. Roberts submits a paper upon the water

supply of French creek, in the course of which he says that although the water supply of the proposed ship canal, is amply sufficient without drawing upon French creek, it will interest many to learn something of the capacity of this stream The Erie Canal's Supply.

The Erie Canal of Pennsylvania (abandoned in 1872) drew its supply of water for its summit 897, 930 level, and for a considerable distance both ways, from the summit, from Conneaut Lake-94,500 the natural supply of the lake being supple-mented by means of a navigable feeder canal, extending from the lake 27 miles to Bemus extending from the lake 2/ miles to Bemus dam, two miles above the city of Meadville, Crawford county. The notion which some residents along the route of the old canal still entertain, viz: That this source of supply was insufficient for the canal, is entirely erron-

Cous, It arose, probably, from the fact of the pecu-\$144, 187 liar and unfortunate arrangement of the sum-mit level of the old canal, the water at times nait ievel of the old canal, the water at times not being able to run out of the lake into the canal of its own volition, and hence the neces-sity of pumping. The pumps must have been either too small or otherwise inadequate for the performance of the required duty, when from any cause the level of the lake was lower than that of the canal prism. The summit level was provided with locks of four feet hift at each end, mating it just four feet higher than was contemplated originally. Such an arrange-ment would have been truly indicrous, had it not been for the lake of funds to dig out the entire length of eight miles of the summit level as originally designed by its engineers. The adequacy of the water supply, says Mr. Roberty is one of the nost important questions belonging to the subject. He then tells of the capacity of the creek, as shown in measure-ment taken at different times, and how its flow could easily be used for the purposes of the 62,710 111,000 100,000 3, 043, 000 890,000

could easily be used for the purposes of the canal.

Route to the Lakes.

Mr. Roberts also has a paper entitled "Route the Lakes via the Allegheny River from Pittsburg." He says: That a feasible route exists from Pittsburg to the lakes via the Allegheny river and French

the lakes via the Allegheny river and French creek, to a connection with the canal line, recommended by the commission, in Crawford county, is not to be doubted. The Allegheny is a river best susceptible of improvement by means of locks and dams. The surveys already made are not sufficiently accu-rate to determine the location of the dams which might be proposed for the improvement of this river. The experience acquired in the improvement of similar streams in this country would probably dictate for dams on the Alle-gheny a lift of about ten feet, or that such a maximum should not be exceeded, excepting maximum should not be exceeded, exceptin

for grave engineering reasons. If, then, a deep canalization of the river should ever be recom-monded, the dams would necessarily be very high structures. The water supply of the Alle-

was made to have the figures complete and ac-curate, and although useful information sup-plementing its own work was furnished it by a special agent engaged in the United States cen-sus work, several small owners could not be found, while others did not properly classify their boats, and a few of the more important shippers omitted the smaller vessels known as "flats," which accompany fleets carrying the fuel of the towing steamers. From reports re-ceived from 22 firms and individuals engaged chiefly in the coal trade, the following figures are herewith presented: are herewith presented: Tonnage. 1, 174, 606 958, 100 120, 800 Number. Coal boats... Coal barges Coal flats

1,407 1,776 645 Totals 8,891 2, 253, 500 Features of River Navigation.

It may surprise many to learn that such a vast carrying capacity should be required for the coal shipped from the Monongahela river, which amounts to about 4,000,000 tons annually, making it appear that the vessels engaged in the trade average only about two loads each per unnum. This somewhat anomalous state of

affairs in this trade arises from the irregularity of the periods of navigation in the Ohio, and the fact that in the majority of the ports to which the coal is shipped no storage facilities are provided, and the coal is accordingly left in

the boats until sold. These craft are short lived, and a large proportion of them are al-ways in the docks for repairs or laid up in other ways, often being aground on the shoals await-ing rises. feet

ways, often being aground on the shoals await-ing rises. Nevertheless, with all the drawhacks which beset the Pittsburg navigators, they can proudly claim the distinction of showing the best devised and cheapest system of transpor-tation known to the world. A single towing steamer can safely transport on one trip from Louisville 30,000 tons of coal to New Orieans in a few days, something which has frequently been accomplished, the cost per mile per ton being sometimes only a fraction of a mill. That two such great avenues for cheap transpor-tation in the interior of America with only 102 miles separating them, as at Beaver and Conneaut barbor, can exist with no means of direct connection, evidences the neglect which the canal between Conneaut harbor and the Conneall naroor, can exist with no means of direct connection, evidences the neglect which has been given in this country to advantages which even a coiony of Great Britain, not to speak of France, Italy or Germany, would so eagerly avail themselves of.

Lower River Interests.

below the city. The Monongahela Slack Water. Monongahela Slack Water. A considerable portion of the paper is de-voted to Pittsburg and to its reputation as one of the best for general gas, steam, blacksmith and coking coals. Attention is then given to river interests on the Onio river below the outlet of

cosing coals. Attention is then given to river interests on the Ohio river below the outlet of the canal. Wheeling and Bellaire mark the western limit of the compact fron manufactur-ing district, which extends along the Mononga-hela and Ohio rivers, from McKeesport, 15 miles above Pittsburg to the points na ned; while its northern boundary is defined by New Castle, Sharpsville, Sharon and Youngstown, on the waters of the Beaver. The proposed canal, passing as it does, down the Beaver Val-ley, bleects this populous, wealthy manufactur-ing region, striking the Ohio river 26 miles be-low Pittsburg and 64 miles above Wheeling. Even without the assurance now given that the Government will build within a few years, at the most, a dam across the Ohio river just below the mouth of the Beaver, the important navigation interests of Wheeling, Steubeuville and Beliaire would demand that locks should be provided at the mouth of the Beaver so as to give access to the canal, for without them steamers and barges would have to be taken up the Ohio river 21 miles to the Davis Island dam, to enter it. The construction of the pro-posed dam, by making an excellent harbor in the Ohio and Beaver rivers, not only adds therefore to the inducement of such a connec-tion, but makes it easier of construction and safer in operation.

safer in operation.

HARBOR OF PITTSBURG.

CONDITION OF NAVIGATION IN THE SEV. ERAL RIVERS.

Physical Features in Connection With the Davis Island Dam and the Monongahela

Navigation-The Great Benefit of the Dam Down the Ohio.

Mr. Roberts devotes considerable space to the physical features of the harbor of Pitts-

Until within the last six years, the depth

burg and the navigation of the Mononga-

hels. He says:

of water afforded in the Ohio river at Pitts-burg was a factor entirely dependent-upon years from 1885 to 1889, both included, the rais-

Erie into the country to be reached by means of This particular shoal has become worse in re-cent years, the result of the reckless encroach-the canal will afford ample means for for-the canal will afford ample means for for-

The canal will afford ample means for for-warding annually an amount of ore even greater than this 462,049 tona. With cargo equal to the average ore cargo received at Ashtabula in 1859, the tonnage named makes something less than 3,084.7 car-goes; any 3,085 cargoes, with 214 days of naviga-tion; this equals 14.41 plus cargoes to go through the canal per diem. Were the vessels, steam and sail together, to make average of no more than 13 trips in the season, a fleet of 288 vessels could do the entire work in question. An ex-amination of the table above will show that we have of sailing vessels from 500 to 1,400 tons "gross" tonnage, 154; and of steamers from 600 to 1,400 tons, 165; making a fleet of 322 vessels applicable to this work. And steamers as large as the Cambria (of 1,578 gross tons) could profit-ably engage in the trade; back cargoes of coal, or other northwest-bound freights being always preservable. cent years, the result of the reckless encroach-ments made by filing out the river banks, and making its waters the receptacle for the ashes and cinders of numerous large manufacturing establishments, and of the refuse coal from mines along the river. Recent legislation has been had from Congress looking to the cor-rection of the evils here complained of, and which have been for years a source of annoy-ance to the interests concerned in the navigation of the rivers about Pittsburg, and efforts are now being made to have the law put in force. If this were done, and particu-larly if the banks of the Monangahela were ex-tended out to properly prescribed lines, this tended out to properly prescribed lines, this particular shoal would disappear of itself, and in any event its removal by dredging to permit of the passage of vessels drawing ten feet of water, is a matter which would involve only a triding set. or other northwest-bound freights being always

Borden Capacity of Vessels.

The extension of the harbor of Pittsburg up the Allegheny river will require some notice. At the mouth of the Allegheny there is a shoal having a depth of not over eight feet of water when the Davis Island dam is raised. It is, however, quite short, and is susceptible of im-provements on as to afford a safe passage for vessels drawing nine feet at a cost of, perhaps, not exceeding \$5,000 to be expended in dredg-ing. Thence for two miles to the Herr's Island dam, now about to be constructed by the United States Government, there is a straight, easy channel with a safe minimum depth of nine feet. Mr. Goodwin also submits a paper upon nominal "tonnage" and actual "burden" of lake vessels, in the course of which he says that the list of merchant vessels annually made up by the Treasury Department gives the gross tonnage and net tonnage of each vessel, but neither the gross nor net figures afford any direct indication of the actual burden carrying

procurable.

neither the gross nor net ngures arord any direct indication of the actual burden carrying capacity of the vessel. A wooden screw steamer to carry 1,400 to 1,500 net tons of cargo, with a draft of 14 feet of water, may very well have dimensions as fei-lows: 200 feet keel. 213 feet over all, 34 feet beam, 2 decks. Total depth from top of upper deck to bottom of keel, 21 feet, measured, of course, at crown of deck amidship. Tonnage depth (Custons measurement) from under side of upper deck planking to top of celling, or floor, in boid, 17.25 feet. Depth of lower hold (under side of hower deck carlings to celling, or floor), 9 feet. Between decks (under upper deck carlings), about 65 feet. Dusplacement of this vessel, at 14 feet draught, would be about 2711 net tons. Weight of vessel, machinery and coal in bunkers, about 1,250 tons, leaving cargo capacity of 1,461 tons. This vessel at 14 feet draught would have 5.375 feet freeboard (i.e., the top of her deck, at the In referring to the subject of bridges, Mr. toberts says that all such structures crossing outh of the Beaver must be made with draws. In view of the restrictions thrown about their construction, and the difficulties to be overcome, their great cost, and the enormous local come, their great cost, and the enormous local business they accommodate, it will be wise to consider the Ohio Connecting Railroad bridge, the Point bridge and the Allegheny river bridges as fixtures. Some of them are of such beculiar construction that they would not ad-mit of being altered to provide for draw spans without being entirely reconstructed with more

This vessel at 14 feet draught would have 6.375 feet irreboard (i.e., the top of her deck, at the side of the vessel, would be 6 feet 45 inches above her load line). She might, therefore, carry 1,500 tons cargo, or even considerably more, without risk, in the lake. On entering a ship canai through which she can steam with-in 45 hours, at no time speeding at a rate great-er than 45; miles per hour, she may have 50 or even 100 tons less than her ordinary stock of fuel on board. A steel vessel of the dimen-sions above given would carry cargo materially in excess of that specified as to be carried by the wooden vessel.

Carrying Capacity Advanced.

The maximum point in cargo carrying capac-city has been largely advanced since 1873; and while the largest screw steamer on the lakes in 1872 was of no more than 1,575 net tons, there are now six of 1,885.14 net tons; one of 1,992.76, one of 1,945.88, and three of about 1,935 net tons, the gross tonnage of the three last mentioned being 2,669 tons each. The fact that cargoes of ore of ureat size, such as those above specified (of -2,969 to 3,390 gross tons), have been carried by lake steamers, has been, naturally, widely heralded, and we find quite generally prevalent an idea that vessels carrying much loss than these great cargoes are in small favor among like ship owners. The fact is, however, that we have now on the lakes 26 screw steamers rang-ing in gross tonnage from 500 to 600 tons each, whereas, in 1872, there were but 12 vessels of that class, and that we have 120 screws ranging from 200 to 600 gross tonnage, where in 1872 we had but 54. 1872 was of no more than 1,575 net tons, there

Monongahela Slack Water.

trifling cost. The extension of the harbor of Pittsburg up

Bridges Must Have Draws.

The slack-water navigation on the Mono gahela is of the most noble proportions. There preupon it nine dams in all, extending the navigation from Pittsburg to Morgantown, W. Va., a distance of 102 miles, with an average length of the pools of about 11% miles. The length of the pools of about 11½ miles. The fact remains that no eugineering difficulties exist calling for the expenditure of more than a few thousand dollars at each of the nine locks and dams on this river to prevent the river from being maile 9 feet in depth through-outlits already improved portion of 102 miles. Mr. Roberts goes at length into the improve-ments that can be made to the Monomzabela dams without extraordinary expense. In case the canal of the proposed depth is constructed, it would be a matter of great importance and an advantage of vast becuniary benefit to the interests of all concerned to have the harbor at Pittsburg improved to correspond with it more nearly in depth than its present condition new admits of, and no effort and no expense would probably be spared by the General Government in doing what was possible to ob-tain so important and emitted practicable a result.

from 200 to 400 gross tonnage, where in 1872 we had but 54. But we had in 1889 127 screws of tonnage greater than the largest of those of 1872. The size of the average Marquette cargo of ores (coming through the Saut caual and the St. Mary's river) has largely increased since 1873, as a consequence of the increased capacity of the Saut canal lock, and the deepening of the St. Mary's river: measurable, too, as an effect of combined influences favoring the use of larger vessels in the ore trade; but the general average tonnage of ore cargoes has not ad-vanced to the mark at which, one taking his impressions from the reports aforesaid, of ex-optional cases, would naturally expect to find it at this time. Cargoes of Coal.

The commission has taken this particular subject into serious consideration, and in re-commending, in accordance with the modern experience, both that of Canada and of Europe,

where the overwhelming advantage of deep, over shallow, canals is now so well recognized, an available depth for the Ohio and Lake Erie canal of 14 feet, believes that to propose a less depth would result in the proved inadequacy of the work in a very brief period following its construction. The aggregate number of cargoes of coal (bituminous, most of which came from Yough-iogheny) shipped from the L. S. & M. S. R. R.

Mean Depth of Water.

In connection with this paper a table is given showing the monthly and annual mean depth of water at Pittsburg from 1872 to 1889 inclusive. During the 18 years the mean annual depth ranged between 4.4 and 6.6 feet, with a mean for

iogheny) shipped from the L. S. & M. S. R. R. Company's docks at Ashtabula, in 1889, was 206. Total number of vessels loaded with coal (some but once and some several times) during season, 180. Since no more than 105 of the oro carriers took coal (as carro), while no freight other than ore was received by lake at the Lake Shore Company's docks during the season in question, the fact is apparent that 34 vessels came to these docks, light, for purpose of tak-ing coal as freight. ing coal as freight. The average cargo of coal taken from the La

Cargoes of Coal.