1888.

NEW ZEALAND.

THE GISBORNE OIL-SPRINGS

(REPORT ON), BY H. A. GORDON, F.G.S., INSPECTING ENGINEER.

Laid on the Table by the Hon. Mr. G. F. Richardson, with the Leave of the House.

Mr. H. A. GORDON, F.G.S., Inspecting Engineer, to the UNDER-SECRETARY of MINES.

Wellington, 20th January, 1888.

IN accordance with instructions I visited the oil-springs at Gisborne, and I have the honour to report as follows :—

The belt of country which shows indications of oil extends from Horoera Point, near the East Cape, to the Okahuatiu Block, the latter place being about thirty miles in a westerly direction from Gisborne. I have marked by red dots on the annexed plan the places where oil is stated by Mr. Stubbs to have been found on the surface.

ORIGINAL WORKINGS.

The first workings where oil was discovered are situate on the top of a flat range between the Waingaromia Creek and the Waiporoa River, about 1,450ft. above sea-level. Several excavations have been made is this locality, the whole of which are full of water, with a thick scum of oil on the top, and a large supply of carburetted hydrogen bubbling up through the water and oil. One of the party who accompanied me set fire to one of these pools, which burned for a considerable time with great violence. The surface-soil in the vicinity of these pools is intermixed in places with paraffine, which forms a consistency having the appearance of antifriction grease. Several attempts have been made to put down a borehole in this locality, all of which have, however, failed, owing to the great thickness of surface-soil and soft rock. A shaft was sunk for 100ft. and close slabbed; but owing to the large volume of carburetted-hydrogen gas met with, and the soft swelling nature of the ground, it was found impracticable to carry on sinking by this method. A borehole was started from the bottom of the shaft, which was got down for another 110ft., but the heavy pressure of gas from the bottom of the hole sent up showers of mud and water to the surface whenever the rods were drawn for the purpose of cleaning out the hole with the sand-pump, so that this borehole had ultimately to be abandoned.

Any one visiting this place cannot fail to be impressed with the abundance of oil and gas in the locality, which has fully warranted the large expenditure made in trying to develop the oil-industry. The whole of the country is covered with papa rock or calcareous marl, and, although the belt of country where the oil occurs is estimated to be from six to eight miles wide, no definite opinion can be formed as to the quantity of oil it contains until the area has been more throughly prospected.

SOUTH PACIFIC COMPANY'S WORKINGS.

This company holds a lease of 6,000 acres of land, which includes the original workings. Indeed, the present company may be called a re-formation of the first company formed to prospect for oil. The original company was formed in 1874, and after having spent some £5,000 the company was put into liquidation, and its interest purchased by a few of the original shareholders, who formed the present company, with a capital of £58,916, in the same number of shares, of £1 each, 15,000 paid-up shares being given to the promoters for their interest, leaving £44,916 to develop the oil-springs. Of this amount £22,000 have actually been expended in boring and prospecting for oil.

The present company has put down nine bores, eight of which varied from 100ft. to 400ft. in depth, and the present borehole, which has struck the oil, is 1,321ft. in depth. The reason of the rest of the holes not being put down to a greater depth was that they were started too small on the top, and, the strata gone through being of a soft swelling nature, one length of tubing could only be driven down for a short distance. The strata to be gone through here was totally different from that to which the men had been accustomed in boring for oil in America, requiring a different method to be adopted.

In the beginning of November last the gas from the borehole caught fire, and the derrick and machinery, with the exception of the engine and boiler, were destroyed. It was first thought that the rapidity of the rods travelling down the pipe produced a spark which ignited the gas in the bore; but it is now generally admitted that the large amount of gas coming from the bore caught fire from the furnace of the boiler. The oil for some time flowed over the top of the pipe, but, on the flames

being extinguished, the oil stood at about surface-level. At the time of my visit the oil was about 6in. below the surface of the ground, and I was informed it generally stands about that level, although on some days it stands higher than others.

Annexed is a section showing the material bored through.

The company is now making preparations for the erection of a new derrick and machinery, and as soon as these are completed operations will be resumed. The first thing required is a large supply of storage-tanks, so as to be able to test the supply the well is capable of producing. The minimum discharge anticipated is 4,000 gallons a day, and it is also anticipated that, on a 2in. pipe being inserted in the borehole, which is 4½in. in diameter, the pressure of gas will be increased to such an extent that no pumping will be required for some time.

It has been found by experience in working the oil-wells in America that one bore will only drain from four to five acres. This is a question that has yet to be determined here, as the strata is totally different from that where oil-springs occur in America, as the strata, instead of lying nearly horizontal, is greatly tilted in New Zealand, lying at angles from 20° to the horizontal to 70°, and in some instances nearly vertical. This accounts in a great measure for the difficulties met with in boring. The tilted strata, forming a foot- and hanging-wall on the borehole, and the hanging-wall in soft seams always cave to a certain extent, which greatly retards the boring.

As this is a new industry in the colony, and likely to become a large one, a description of the plant and machinery required for boring may be interesting, as it is very simple, effective, and comparatively inexpensive, the total cost of a complete plant, not including tubing for the borehole, being about £1,600.

Plant.

The plant consists of a steam-engine and boiler, two winding-barrels, one for lifting the sand-pump and another for lifting the rods, a walking-beam for working the rods, derrick, two coils of rope, and the necessary bits and tools for boring, together with about 54ft. length of rods.

The plan marked A will show the whole arrangement of the plant required for boring. The derrick and the foundations, with intermediate framing, are the principal things requiring close attention in the construction of the plant.

As soon as the plant is erected boring operations can be commenced. In the case of the South Pacific Company the diameter of the borehole on the top was started at 9½in., going through shingle and boulders for the first 85ft. This diameter was maintained for some distance into the papa rock; but the first length of tubing could only be driven for 108ft., after which the diameter had to be decreased to 8in., and finally, at 1,104ft., it had to be decreased again to 6in. This is considered the smallest diameter for a borehole it is advisable to use in sinking an oil-well.

General System of Boring.

The rods used for boring wells are made of the best Low Moor iron, 3in. in diameter, and, including the bit, are 57ft. in length, weighing one ton and a half. The bit proper is 3ft. in length, having 1ft. of solid steel on the lower end, and on the upper end there are a screw and collar, which are turned and chased in a lathe, the bit being screwed into a socket on the lower end of the rods. On the top end of the rods there is a socket, into which is fixed a cable-laid Manilla rope, 6in. in circumference, with which the drill is worked.

The rope which is attached to the rods is brought over the pully fixed on the top of the derrick, and brought down to the winding-drum, which is about 18in. in diameter and 12ft. in length. This drum has a pully on each end 8ft. in diameter, one of which is for the brake to work on, and the other for the belt, the latter being only used when the rods require to be hauled up to the surface.

The derrick is about 70ft. in height, made entirely of planks, and bolted together. The reason the derrick is so high is to allow the length of rods to be hauled up above the surface each time the hole requires to be cleaned out.

In starting a borehole the rods are lowered down by a brake until the drill rests on the solid or bottom of the hole. The rope is then attached to a screw, which is fixed on one end of the walking-beam, as shown in the diagram of tools marked B. It will be seen that there are two half-round clips which are placed on the rope, and held together by a screw-clamp. This takes the weight off the rods, and the screw is for the purpose of lowering the rods as the boring progresses. On the other end of the walking-beam there is a connecting-rod attached to a crank, which is fixed on an intermediate shaft driven by the engine. This crank has a throw of about 15in., which is equal to 2ft. 6in. stroke, and is worked at the rate of about forty strokes a minute, the boring being done by the weight of the rods falling each time.

Before commencing a borehole a shaft is generally sunk for some distance through the surface-soil and boulders in order to get room between the end of the walking-beam and the mouth of bore, and also to lessen the difficulty of getting through the loose ground on the top.

Where the ground is of loose material on the top stone pipes made of 14 B.W.G., 13½in. in diameter, are used. These are pressed down as the boring progresses, and when they cannot be pressed down any further a drill-bit the same size as the inside diameter of the pipe is then used. The hole is carried down without piping as far as possible, or until it is found that the hole will not stand without tubing any further. The tubes then used are made on the same principle as gas-pipes, having screw couplings outside. These tubes are driven down by a monkey weighing about two tons to such a depth as it is possible to force them. I was informed that in driving the 6in. and 8in. pipes a drop of 15ft. is used to force them down.

The reason for boring the hole as far as possible without pipes is obvious. The hole can be drilled to the full size at once, but if pipes have to be inserted a smaller bit has to be used, and the hole afterwards rimed out before the pipes can be driven down. This increases the cost of boring considerably.

When boring in rock the practice is generally to bore about 5ft. before drawing the rods—that is, before it is necessary to clean out the hole with the sand-pump. When the rods have to be drawn a strain is taken on the rope from the winding-barrel, the clamp which attaches the rope to the screw is loosened, the belt passed on to the pulley, and the rods lifted above the surface of the ground and held a little to one side of the hole by a guy-rope. The sand-pump is then let down by a separate winding-barrel, and the hole is thoroughly cleaned out.

The sand-pump is a tube about 4in. in diameter and 5ft. long, having a valve at the lower end and open at the top. This has a rope attached to it, and when it comes to the surface the tube is emptied and sent down time after time until all the material is out of the hole. The sand-pump is then detached from the rope, and another tube put on for filling the hole with water. When boring operations were first commenced here the water was simply poured in at the top of the pipe, but it was found that the action of the water falling down the sides of the borehole, especially on strata highly inclined, was the means of the holes caving to a great extent, and this led to the adoption of a tube, having a spear-valve at the bottom to charge the hole with water. This tube is 3in. in diameter and 15ft. long, having a spear projecting below the bottom, which opens the valve as soon as it touches the bottom of the hole. The tube conveying the water used for boring is by this means landed at the bottom of the hole, and the water has not then the same tendency to soften the rock as that it has when falling down the sides. The drill is then lowered down to the bottom of the hole by a brake, the rope held fast by clamps to the screw attached to the walking-beam, and boring again resumed.

The screw-nut is made in two halves on the end of the shears, and held together wit a clamp and steel-set pin. This arrangement allows the screw to be lifted up through the nut by simply slacking the set-pin, and when in its place the set-pin is again tightened to hold the two halves of the screw-nut together.

There is a swivel on the lower end of the screw to allow the rope and rods to be twisted round as the boring progresses. The whole arrangement is very ingenious, and can be fully understood by referring to the diagram showing tools, marked B.

Rate of Boring.

The rate of boring depends not so much on the hardness of the rock as on its inclination to cave, when everything goes on well, or when very little caving takes place. About from 30ft. to 35ft. on an average is bored in twenty-four hours; but, taking the time occupied in driving and putting in the tubes, it is reckoned that boring can be carried on under ordinary circumstances at the rate of 20ft. a day, and that the cost of same without tubing is on an average about £1 per foot. The cost of tubing depends on the sizes of the pipes used.

It will be seen from the section of the borehole that an 8in. pipe is down to a depth of 108ft., after which a 6in. pipe is used to a depth of 1,104ft., below this a 4½in. pipe is down to 1,260ft., and below this depth there is no tubing.

As soon as the derrick and other machinery are erected, a 2in. pipe, having a ball-valve fixed at the lower end, will be put down inside the 4½in. pipe, and held in position by an indiarubber socket or barrel—that is, there is a piece of indiarubber 4½in. in diameter, with a hole through the centre of it sufficiently large to allow the 2in. pipe to pass through. When the 2in. pipe is down to the required depth, the indiarubber is screwed together, on the same principle as S. Humble's blasting-plugs, and this holds the pipe in position, and prevents the escape of gas.

On this 2in. pipe being put down, the surface that the gas can escape by is reduced from 15·9 square inches to 3·14 square inches, or to about one-fifth; this will cause the pressure to accumulate, and by this means the company consider their well will be self-delivering for some time before pumping will have to be resorted to.

The present borehole, where the oil has been found, is situated on the side of the Waingaromia Creek about four miles up from its junction with the Waiporou River, and about two miles and a quarter distant in a due easterly direction from the place where oil was first discovered. The site of the present bore is not on the company's original lease, but on a special lease of five acres adjoining the original one, at an elevation of about 370ft. above sea-level.

It may appear strange that there is a large supply of oil at the surface at the old workings, which is 1,450ft. above sea-level, and at the present borehole, where the oil has been found, which is only 370ft. above sea-level, while their distance from each other is only two miles and a quarter; but this, I think, can be satisfactorily explained.

Above the oil-formation is a certain thickness of a dark-grey calcareous marl known locally as papa rock. The thickness of this rock varies considerably in places, according to the anticlinal arches or synclinal troughs of the oil-formation. The old oil-workings I take to be near the top of an anticlinal arch where the newer strata are not so thick, while the present borehole is more towards a synclinal trough, or it might be that the old working is near the vicinity of a slide; but, be that as it may, it is clear that the rock is more loose and disjointed at the old workings than near the vicinity of the present borehole; and, if the old workings are directly above an anticlinal arch, the gas would naturally rise to the highest point in the oil-formation, and, if the superincumbent strata were not so great, it would be more likely to find its way to the surface.

Future Prospects of the Company.

The South Pacific Company has now arrived at this stage: It has found that a supply of oil is to be had in the locality, but what that supply is cannot yet be determined. The manager, Mr. Weaver, who has large experience of the oil-springs in Pennsylvania, is under the conviction that the daily supply will not be less than 4,000 gallons, still this must be looked on as merely an estimate until it is proved, and this cannot be done until a large supply of storage-tanks is on the ground. When the supply is determined the oil-industry may be said to have entered the second

stage of its existence; and in order to make it a commercial success a large expenditure will have to be made in laying down pipes to convey it from the springs to Gisborne, and also in the erection of refining-works at that place.

The distance that pipes would have to be laid is about thirty-five miles, which is only a short distance in comparison to the pipe-lines in America, which are 600 miles in length. The head also on the pipe will be sufficient to cause the crude oil to run without pressure; the only thing to be determined is whether the temperature during the winter months will congeal the parafine which exists in the crude oil. If this takes place additional pressure will have to be applied.

From the present prospects there is every probability of the oil developing into a very large industry. I think there is little doubt that a large supply will be obtained, but it becomes a question now of capital to develop the springs and make them a commercial success. This will take time even if capital is at once forthcoming, and, although I have little doubt as to the ultimate success, still, I think, that two years will yet elapse before the company will be in a position to supply.

Minerva Company.

This is a company, recently formed, in 50,000 shares of £1 each; £5,000 of the capital is paid up, out of which £3,000 has been expended. This company hold a lease of 200 acres of land on Mr. Henry Campbell's station, for which the proprietor of the land receives 10 per cent. of the gross proceeds of the crude oil extracted from the ground. Boring operations were commenced on the 5th December last, and on the 4th January, the date of my visit, the bore was down for 222ft., and 100ft. from the surface was tubed with stone pipe 13½in. in diameter.

Mr. Stubbs, the manager of this company, accompanied me all over the district and gave me much valuable information respecting the places where oil shows on the surface. He, having been largely interested in all the oil companies in the district, and intimately connected with their workings for the last fourteen years, has kept records of the different strata gone through, as well as a diary showing the progress made day by day in boring. He was therefore in a position to give authentic information as to the progress made and the difficulties the companies had to contend with. It is from this information that I am able to give sections of two of the deepest bores in the oil-belt.

The machinery and plant of the Minerva Company is similar to that previously described and shown on plan attached. The steam-engine used for working the machinery has a 10in. cylinder, American make, and fitted up with superheating apparatus, very compact, strong, and cheaply got up; the cost, landed in the colony, being only £60. There is a very cheap and ingenious contrivance for working the barrel which winds up the sand-pump. It slides out and into gear by means of a lever, and is worked by a level-pulley being pressed against the wooden wheel on the crank-shaft. The whole thing sits on a skew, but the pulley on the top of the derrick is placed at right angles to the line of winding-barrel. All barrels, wheels, and pullies are made of wood, and answer the purpose extremely well. The whole of the brakes and starting-bars are fixed close alongside the borehole, so that one man can attend to them as well as the boring operations.

The Minerva Company carries on boring by three shifts of two men, day and night continuously —Sundays excepted. During the time of my visit the first sandstone bands were struck at 221ft., which gave off a large quantity of carburetted-hydrogen gas. This band corresponds with that found in the South Pacific Company's borehole at 470ft. The manager is therefore of opinion that he will strike oil at 250ft. less depth than it was got in the South Pacific Company's bore.

To test the quantity of gas given off in the borehole the manager, after clearing out the hole with the sand-pump, dropped a small piece of ignited waste down the borehole, which produced a loud explosion, sending water and mud out at the top. The distance that this company's bore is from the one where oil is found is about four and a half miles.

The cost of stone piping 13½in. in diameter is about 2s. 6d. per foot landed at Gisborne, but the malleable iron pipes, with screwed couplings outside, having an inside diameter of 8in., cost about 10s. per foot.

Southern Cross Company.

This company's workings are situate on the northern and western side of the Waiapu River, about forty-five miles in a north-easterly direction from the South Pacific Company's leasehold. I did not visit this locality, as all boring operations are suspended.

This company was formed in January, 1881, with a capital of £48,000, of which amount £46,000 have been actually expended in boring operations, plant, and machinery. During the time the company was at work seven boreholes were put down, varying in depth from 150ft. to 1,820ft.; the latter being the depth of the last borehole when the cable attached to the rods broke, leaving the rods in the bottom of the hole, and, after trying for seven months to recover them without success, the company finally suspended operations.

In all the holes that the company put down a considerable quantity of carburetted-hydrogen gas was met with, and in the last hole a little oil was found.

From all information I could get respecting the oil-belt, it would seem to go under the sea at the East Cape. Several people at Gisborne stated that oil is found at Horoera Point, and that it can be seen on the surface of the ocean in fine weather. There have been no indications of oil found, as far as I could learn, eastward of the line dotted red, and shown on the map as the probable boundary of the oil-belt. The surface-rocks are, however, of the same character all over the district, and the depth of the papa rock seems to increase to the northward and eastward.

The following is a section of the last bore put down by the Southern Cross Company, from information received from Mr. Stubbs:—

Annexed is a plan, marked C, of the refining plant which the company propose erecting at Gisborne as soon as the oil-supply is fully established and a pipe-line laid down.

From all I could gather from those connected with the oil companies and boring operations, a large number of mistakes have been made and money wasted. Even the men who came from the oil-region in America were entirely at a loss as to the most economical method to contend with the difficulties that had to be encountered, the conditions of things being entirely different to that which they had been accustomed to. They are now, however, gaining more experience.

As to the width and extent of the oil-belt it is at the present time purely a conjecture. But no doubt, now that oil has been struck, a number of boreholes in different localities will be put down, and, more especially, the oil will be traced up step by step by the South Pacific Company from their present borehole, which will give more definite information on the subject. No doubt breaks will be found in the country, which may interfere to a large extent with the supply of oil; but, as the oil-belt gets developed, difficulties which now stand in the way will vanish, and more capital will be embarked in the indusry. Judging from what I have seen, I think the supply of oil will develop into an important industry, but it will take a few years before this will be fully established.

HENRY A. GORDON, Inspecting Engineer.

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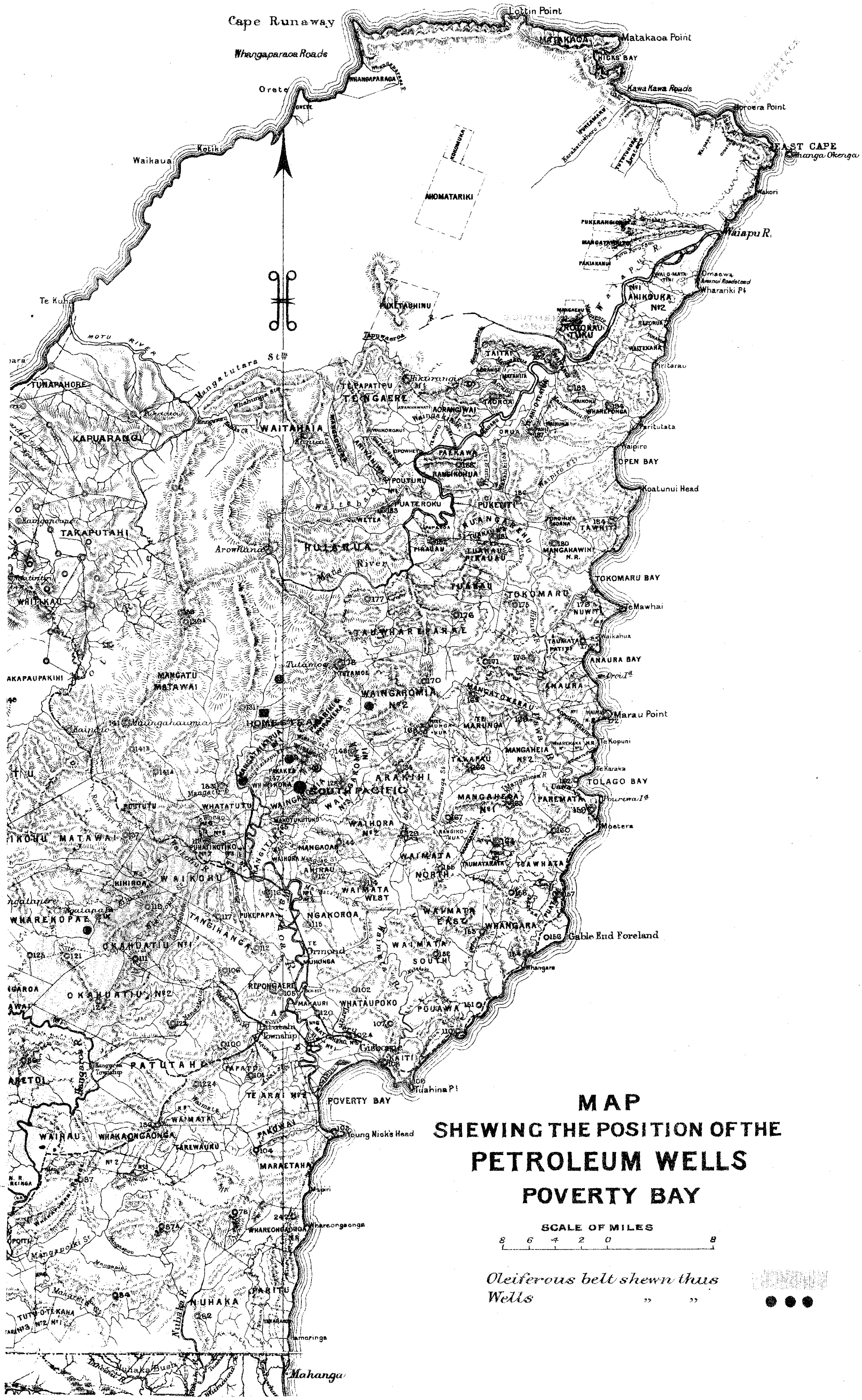
By Authority: GEORGE DIDSBURY, Government Printer, Wellington.—1888.

From all I could gather from those
large number of mistakes were being
oil-region in Ayrshire very prettily

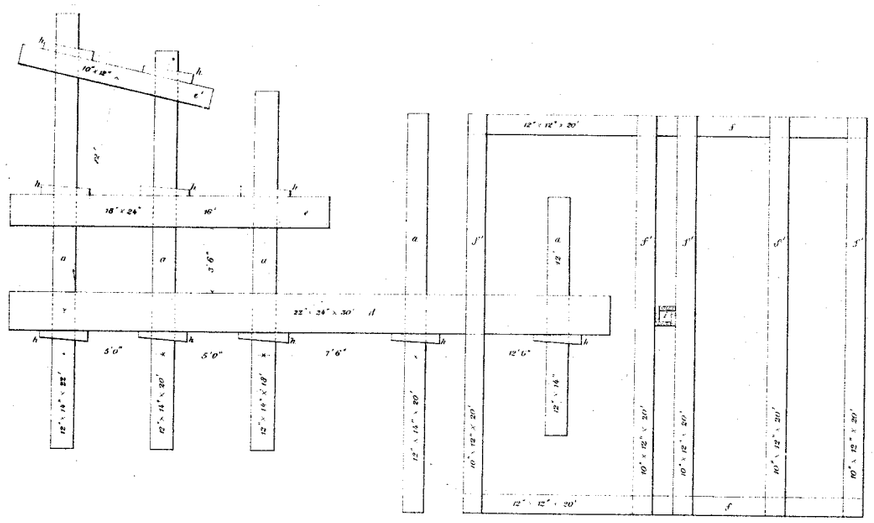


MAP
SHEWING THE POSITION OF THE
PETROLEUM WELLS
POVERTY BAY

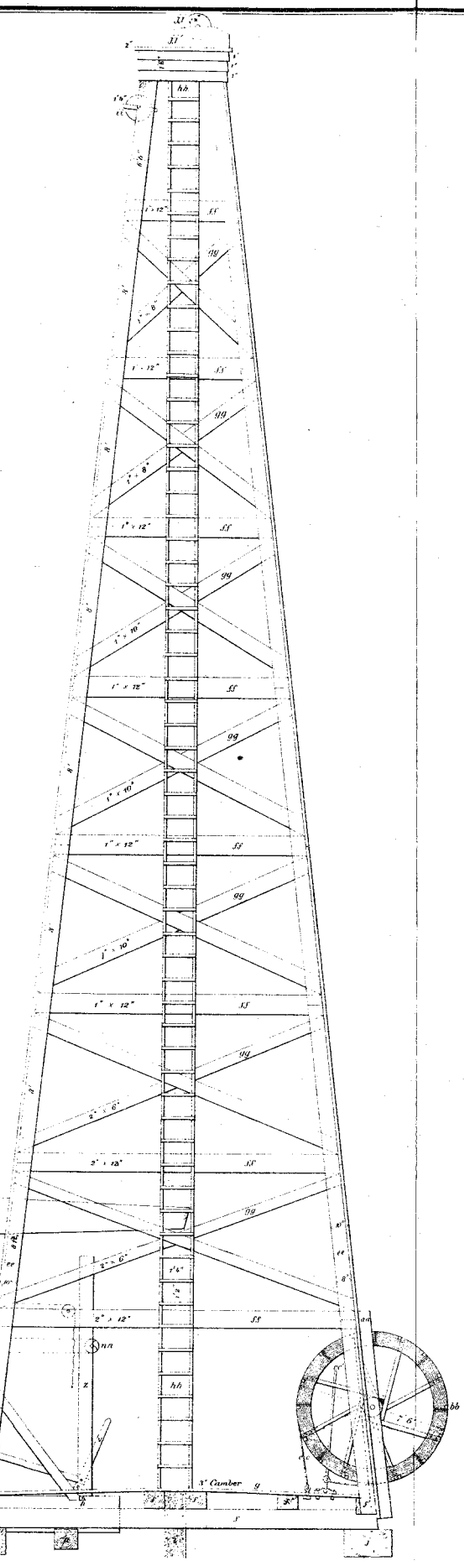
SCALE OF MILES
8 6 4 2 0 8

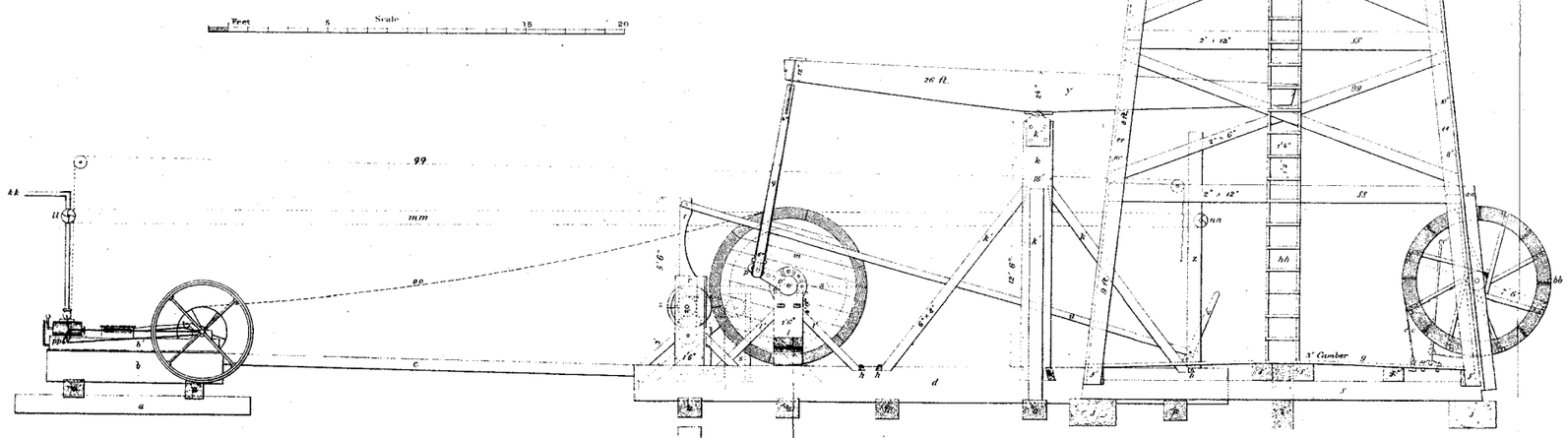
Oleiferous belt shewn thus
Wells " " ● ● ●

A

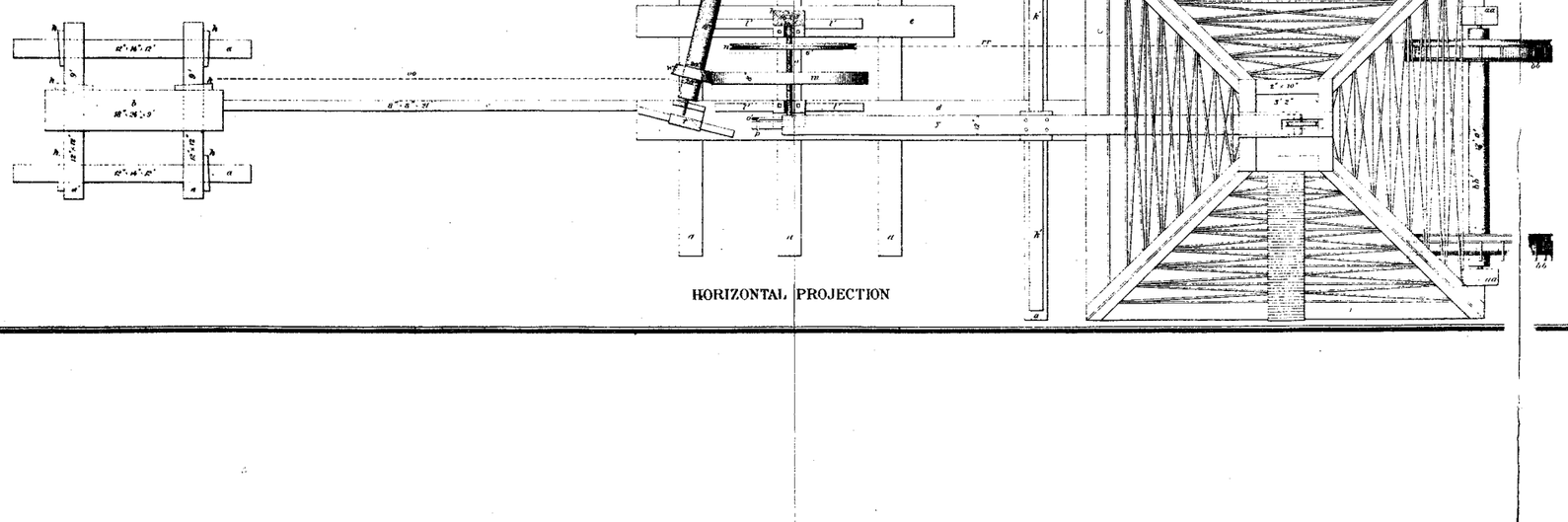


FOUNDATION TIMBERS

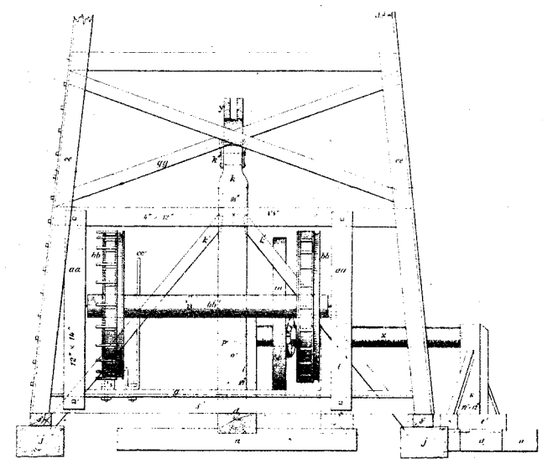




SIDE ELEVATION



HORIZONTAL PROJECTION



END ELEVATION

TABLE OF REFERENCES.

FOUNDATION.

- *a* Mud-Sills
- *a'* Cross Sills for Engine-Block
- *b* Engine-Block
- *b'* Engine
- *c* Engine Block Brace
- *d* Main-Sill
- *e* Sub-Sill for jack post of band-wheel
- *e'* Sub-sill for jack post of sand-pump reel
- *f* Derrick Sills
- *f'* Derrick Floor-Sills
- *g* Derrick Floor
- *h* Keys or Wedges
- *i* Conductor
- *j* Corner Stones or Blocks

SUPERSTRUCTURE.

- *k* Samson-Post
- *k'* " Braces
- *k''* " Irons
- *l* Band-Wheel Jack-Posts
- *l'* " " Braces
- *m* Band-Wheel
- *n* " Bull-rope Pulley
- *o* " Shaft
- *o'* " Arm
- *p* " Wrist-Pin
- *q* Pitman
- *r* Knuckle-Post for Sand-Pump Reel
- *s* Jack-Post " " " "
- *t* Upright Lever
- *u* Connecting Bar
- *v* Hand-Lever in Derrick
- *w* Friction Pulley of Sand-Pump Reel
- *x* Shaft of Sand-Pump Reel
- *y* Walking-Beam
- *z* Headache-Post
- *aa* Bull Wheel Posts
- *bb* Bull Wheels
- *bb'* " Shaft
- *cc* " Brake Band
- *cc'* " " Lever
- *ee* Derrick Stiles
- *ff* " Girths
- *gg* " Braces
- *hh* " Ladder
- *ii* " Sand-Pump Pulley
- *jj* " Crown-Pulley
- *jj'* " " Block

GEARING, &c.

- *kk* Steam Pipe connecting with Boiler
- *ll* Throttle Valve
- *mm* "Telegraph," cord operating throttle
- *nn* Pulley in Derrick " "
- *oo* Driving-Belt
- *pp* Reverse Link of Engine
- *qq* Cord operating Reverse-Link from the Derrick
- *rr* Place of the Bull-Wheel Rope

MECHANICAL DRAWING
OF A COMPLETE
OIL WELL DERRICK
OR
CARPENTER'S RIG

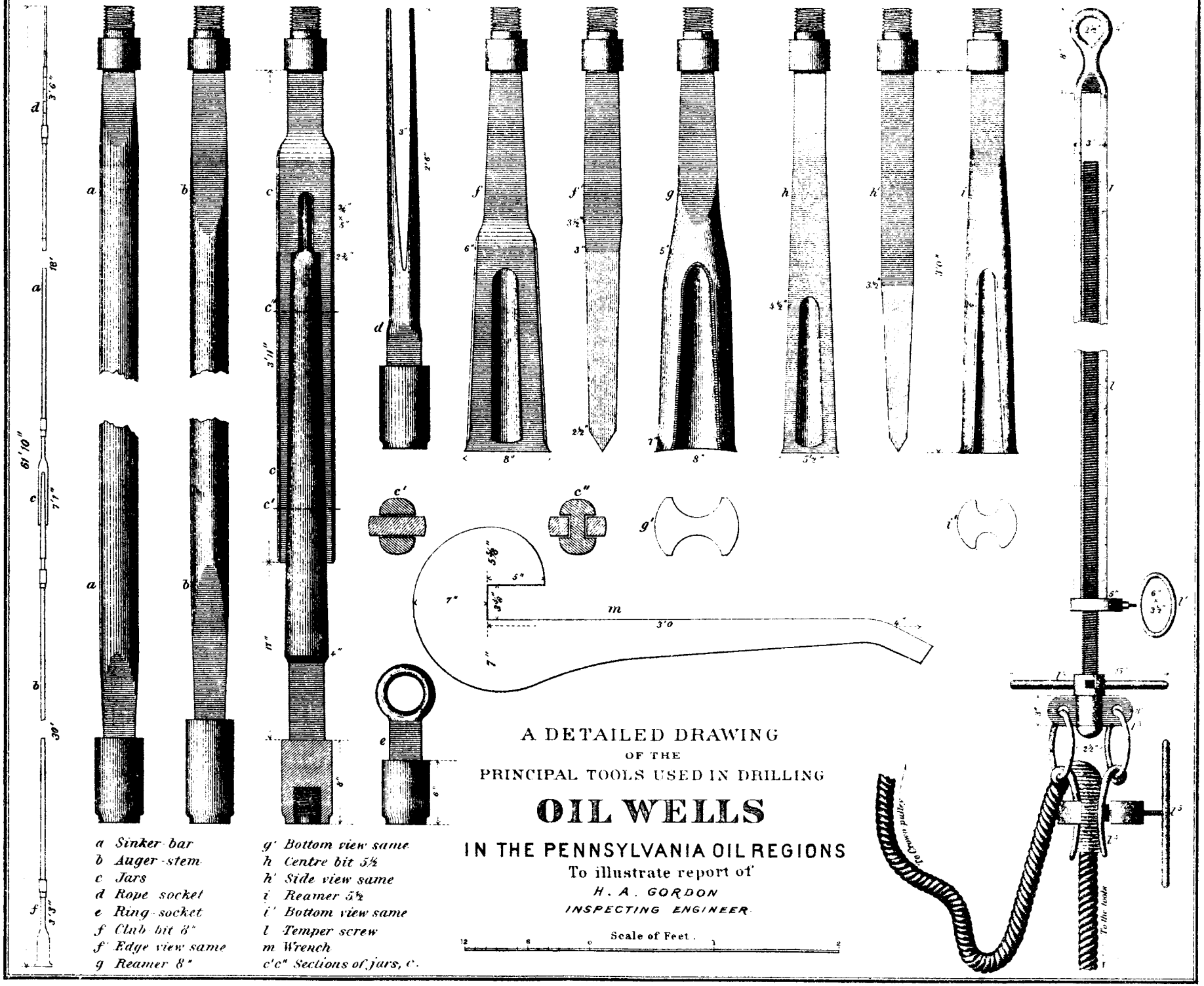
SHOWING IN DETAIL EVERY PART OF ABOVE-GROUND MACHINERY FOR DRILLING AN OIL WELL, AND GIVING THE DIMENSIONS OF THE MATERIALS REQUIRED IN ITS CONSTRUCTION

To illustrate Report of

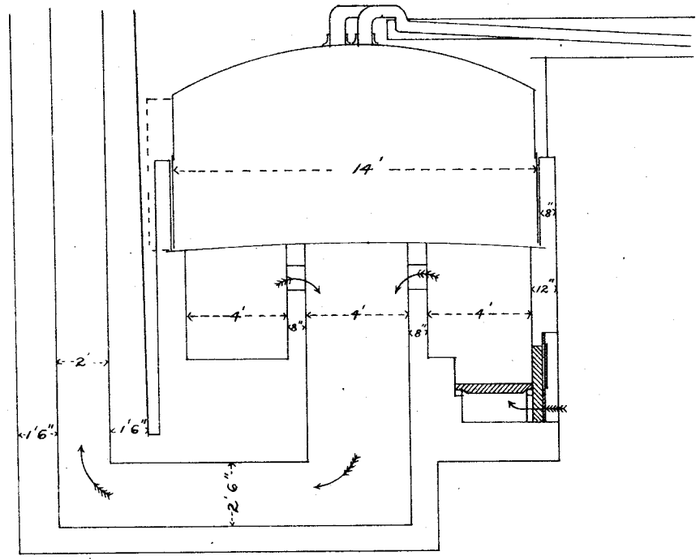
H. A. GORDON

INSPECTING ENGINEER

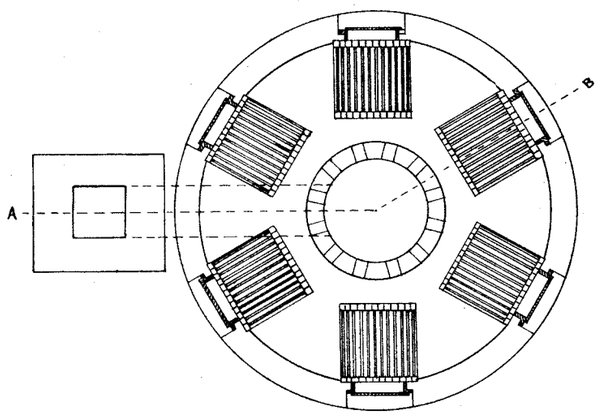
B


a Sinker bar
b Auger stem
c Jars
d Rope socket
e Ring socket
f Club bit 8"
f' Edge view same
g Reamer 8"
g' Bottom view same
h Centre bit 5½
h' Side view same
i Reamer 5½
i' Bottom view same
l Temper screw
m Wrench
c' c" Sections of jars, C.
A DETAILED DRAWING
OF THE
PRINCIPAL TOOLS USED IN DRILLING
OIL WELLS
IN THE PENNSYLVANIA OIL REGIONS
To illustrate report of
H. A. GORDON
INSPECTING ENGINEER
Scale of Feet.
Pitman
Walking beam
To the tools

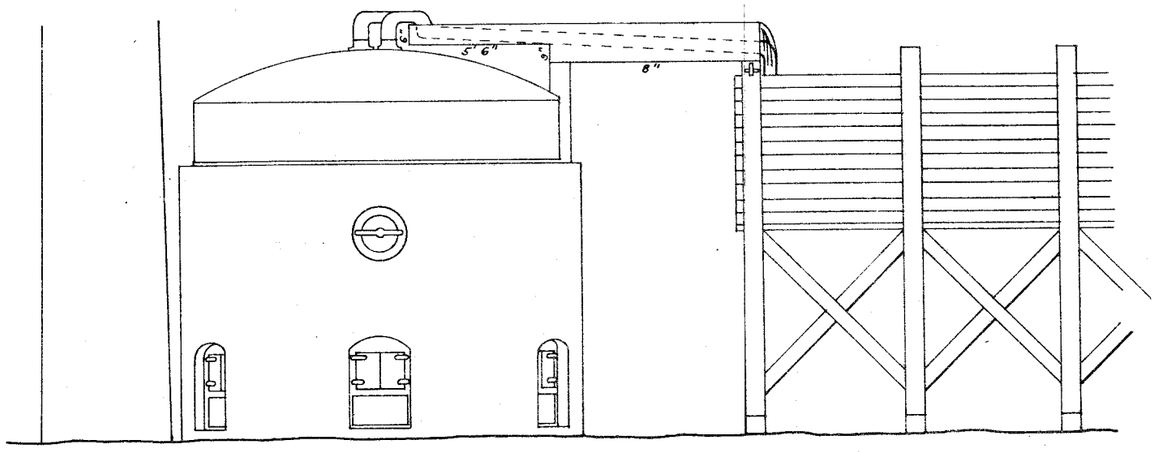
C



Section through line A.B.

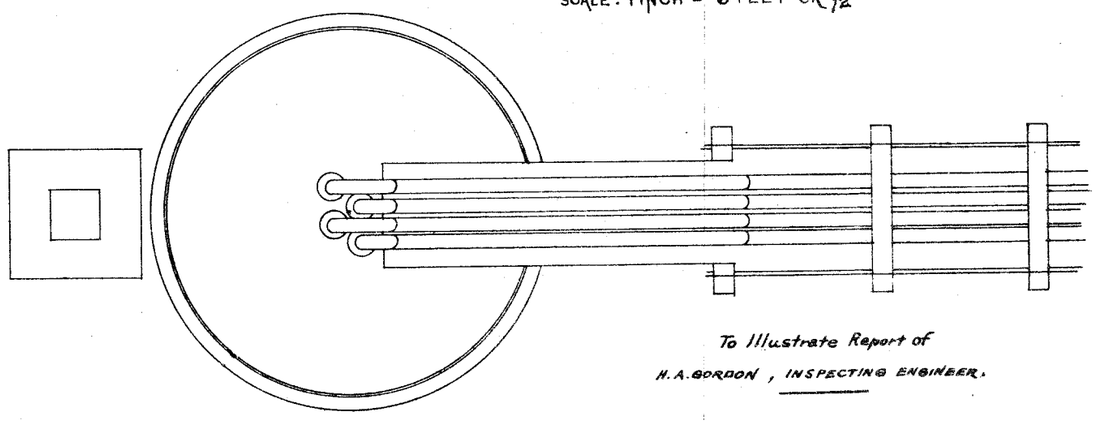


Horizontal section above grates



VERTICAL VIEW

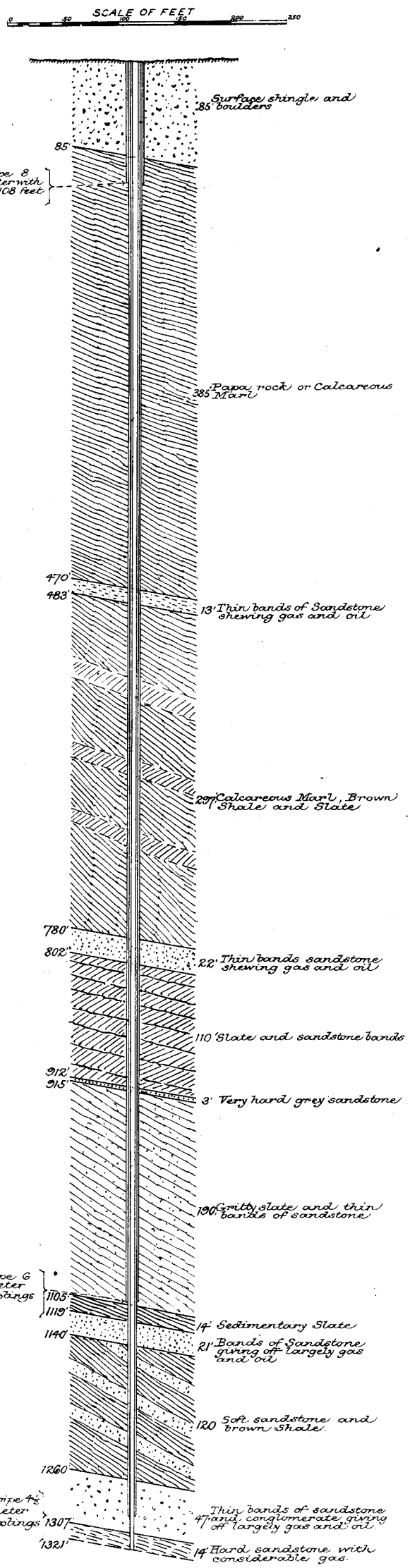
DRAWINGS OF STILL
FOR
OIL REFINERY
Capacity 6900 galls:
SCALE. 1 INCH = 6 FEET OR 1/72



To Illustrate Report of
H.A.GORDON, INSPECTING ENGINEER.

PLAN OF TOP

SOUTH PACIFIC COMPANY'S BORE



SOUTHERN CROSS COMPANY'S BORE