The 1900s

In September of 1900 the Lowrie Irrigation Canal at Spreckelsville Plantation on Maui was completed. Easily ranked among Hawaii's most impressive engineering projects, the ditch was named in honor of its designer, William J. Lowrie, manager of the Hawaiian Commercial and Sugar Company's plantation and mills at Spreckelsville.

Built at a cost of 235,000, the ditch was capable of carrying 60 million gallons of water a day from Makawao, on Haleakala's western slopes to the barren uplands above Spreckelsville. ~~Built through~~ Traversing extremely demanding terrain which seemed to contain "not more than two running feet of flat land", the ditch cut through dense jungles of lauhala, bamboo, koa, kukui and tree fern. Its formidable statistics included 4 miles of tunnels, 1,965 feet of flumes and 85,957 feet of excavations. A 120 million gallon resevoir was built at Papaaea, producing a body of water measuring 800 feet long by 500 feet wide.

Completed in the ~~unbelievable~~ incredible time span of just over one year, the Lowrie Canal reclaimed more than 6,000 acres of arid land. Newspaper accounts of the day lauded the fact that "from start to finish, not one major injury to the Japanese laborers building the ditch was recorded".

Honolulu continued to magnify its role as the center of Pacific trade. The United States was steadily adding to its already formidable military investments in Hawaii, and the presence of an increasing militia had some interesting side effects on Honolulu's civilian population. One of the city's best known, and certainly one of its most colorful characters was Kauhane, the "whistling bosun". Dressed in a military suit which he had festooned with odds and ends of military medals, and carrying a toy sword or a short stick he paraded the wharves and streets for many years, always appearing where the crowds were thickest. Given to calling out "all hands on deck", or "wela ka hou" in a loud and commanding voice, the "whistling bosun" earned his title one day as a returning Man-o-War made its way into port. Standing in a large crowd at the end of the esplanade, and watching as the ship swung around to back its anchor, Kauhane suddenly let go with an expert imitation of a bosun's whistle sounding attention, then cried out "Let go your anchor. To the delight of the crowd, and to the disconcertion of the pilot and officers the order was promptly obeyed.

1900 was to be the year that decided the destiny of Waikiki Beach, indeed shaping the economic future of tourism in Hawaii for many years to come. Noting the increased number of steamers that were calling on Honolulu, and the rapidly growing influx of visitors that

they brought with them, a group of Honolulu businessmen responded to the "increasing evidence that Waikiki Beach needs accomodations as elaborate and attractive as those of other famous water places", and formed the Moana Hotel Company, Ltd. According to the prospectus issued, the firm was capitalized for $100,000, with the "privilege of increasing the amount to $250,000, as necessary.

Designed by O.G. Traphagen, the project first called for the construction of a number of "airy cottages", to be located on the Peacock property, just beyond Long Point. These plans were soon changed, however, and by year's end finishing touches were being added to the costliest and most elaborate hotel ever constructed in the Hawaiian Islands.

The main floor of the four-story structure contained a billiard parlor, saloon, offices, a library and a reception parlor, and was fronted by an elegant port-cochere, supported by 30 foot Corinthian columns. Trolley cars off-loaded passengers nearby, Other features included 75 first-class guest accomodations, and a generator to supply power and light. The facility also boasted its own laundry, described thusly by a journalist of the day:

"The advantages of a laundry in the hotel will probably be better understood by the people of Honolulu than by visitors from St. Louis,

Chicago, or New York. Laundry work is carried on here by Chinese, for the most part. In consequence, the menace to health has been generally acknowledged but no remedy has ever been put into effect. The Moana Hotel will keep this item of its business under its own eye."

Contractors for the project were the Lucas Brothers, lauded for their "attention to quality of material and workmanship". The fact that the venerable old structure is still very much in use ~~today~~ 75 years later is testimony indeed that the plaudits were well deserved.

In November of 1900, one Andrew Gray of the Marconi Company sent and received the first messages between Oahu and Molokai, forging the first link in a chain of communication which would soon bind all of the islands.

In a summation of the year's activity it was noted that, "new thoroughfares have been opened up and street widenings effected in various parts of the city so far as appropriations and well disposed, or public spirited property owners permitted. Much contemplated work of this character, however, has come to a standstill owing to the high price demanded by owners for the land required."

Official notices sent to property owners requiring the construction of concrete sidewalks as far out as Thomas Square quoted the following statut

REVISED LAWS OF HAWAII, SECT. 1899, Chapter 118, "Honolulu, Hilo. "After the establishment of the grades of streets in Honolulu and Hilo, as by law prescribed, the said board of supervisors may require the owners of the land adjoining any street, the grade of which has been established, to construct sidewalks in accordance with the grade of the street and to comply with the regulations regarding the material and constructions of such sidewalks".

REVISED LAWS OF HAWAII, SECT. 1897, Chapter 118, Width. Regulations. "In all cases the construction and maintenance of sidewalks shall be subject to such regulations regarding grades, width, height, material and method of construction as may be from time to time promulgated by the Board of Supervisors".

Honolulu's water supply was markedly improved with the opening of the Kalihi pumping station, located at the terminus of the tramway line. Erected by the Public Works Department, under the supervision of William Mutch, the plant could draw 5 million gallons of water per day from its three artesian wells, and was equipped with pumps manufactured by the E.P. Allis Company of Chicago, Illinois.

Buildings under construction included the Stangenwald Block,

the Lewers and Cooke and the Malt and Brewing Company buildings on Queen Street, the Hackfeld Building, and the Automobile Company complex on King Street. A new wood and stone structure for the German Lutheran Evangelical Church was also being built on Beretania between Punchbowl and Miller. Architect was C.W. Dickey, and the cost was $10,000. Further out, the Kewalo district reflected growing interest by the city's businessmen, with the building of new facilities for the Oahu Ice and Electric Company, the A. Harrison Mill Company, the Pacific Vehicle and Supply Company, and the Sanitary Laundry.

One C.S. Desky, a developer, was credited with installing the city's first electric streetlights at his Pacific Heights tract. Power was from his own, "well appointed" light plant.

The year 1901 saw the formation of what may have been the predecessor to the General Contractor's Association. Known as the "Master Builder's Association", the organizations's first president was contractor John Ouderkirk, who lived on Makiki Street near Wilder Avenue, and maintained offices on King Street near Fort. Vice President was Fred Harrison, a builder and owner of the Monumental Marble Works, and Secretary was J. Langston, a partner in the firm of McDonald and Langston, whose offices were located at 1170 Union Street. Other members listed were

William P. Barry, John H. Craig, Thomas A. Pettus and F.W. Beardslee. However lofty its purpose, by 1902 the Master Builder's Association had been dissolved, and was succeeded by the "Builder's and Trader's Exchange". In mute testimony to the differences that may have caused this quick turnabout, only Beardslee's name appeared as a member of the new organization. By 1907 there were no further newspaper accounts of the Builders and Traders Exchange.

In 1901 Honolulu was introduced to the steel frame, a "revoluntionary" new method of construction, first perfected in far-off Chicago, Long hampered by the structural demands of masonry construction, which required that every additional story in height added corresponding thickness to the walls of the ground floor, architects, builders and businessmen alike rejoiced at this time, money and space saving new technique. Among the first steel-frame structures to appear on the skyline were the Hackfeld Building and the Alexander Young Hotel.

In August the Honolulu Rapid Transit and Land Company announced that all connections had been completed, and that an "excursion for company officials and dignitaries" would announce the formal opening of the line. The route began at Wilder near Punahou, and ran via Pensacola, Kinau, Alapai, Hotel and King Streets to Wyllie and Liliha. A short time

later the line would be extended to include runs to Manoa and Kalihi. The cars were reported to be of "first-class construction", and were built by the Duplex Car Company of Bucyrus, Ohio. The contract for assembly in Honolulu was awarded to the American Car Company of St. Louis, Missouri.

While enjoying much in the way of new prosperity, Honolulu's citizens were also becoming increasingly concerned about their escalating cost of living. A listing of typical prices read as follows:

Prime Rib	.20 a lb.
Eggs	.60 a dozen
Butter	.40 a lb.
Gasoline	.37 a gallon
Cement	$3.25 a barrel
Lumber	
Northwest	$30.00 per 1,000 fti.
Redwood	$35.00 per 1,000 ft.
Oak	.16 per foot

Among the buildings constructed in 1902 was a new structure for Lewers and Cooke, Ltd. Situated on King Street, between Fort and Alakea, the lot had 154 feet of frontage, with an average depth of 138 feet, and was formerly the C.T. Gulick homestead. The three story building was constructed of brock, with a pressed brick and terra cotta front. The building featured fluted iron columns and large plate glass windows along the front. Electric freight elevators were also featured.

Planned by O.G. Traphagen, architect, the building was erected by the Hawaiian Engineering and Construction Co. The contract price exclusive of elevators, was $109,926. The building was used by Lewers and Cooke as their main office and store for handling building materials, builder's hardware, wall paper, matting, glass, etc.

A gala reception on July 31, 1903 marked the opening of one of Honolulu's most formidable structures to date. On that day government officials and the "social elite of the city" turned out for ceremonies celebrating the opening of the 300 room Alexander Young Hotel. Built of Colusa sandstone, the massive four-story structure boasted concrete floors, and interior partitions of metal lath and plaster. Its rooftop featured an elegant restaurant and ballroom in a garden-like setting, both to become fixtures of the Honolulu social scene for many years to come.

Its owner, Alexander Young, had been a resident of Hawaii since the 1860's, and was recognized as a leading iron-master and mechanical engineer.

Amidst predictions of the "great economic prosperity" it would bring to the islands, on January 24, 1905 the first rubber plantation ever planted on American soil was started at Nahiku, on Maui's Hana coast. Operated for several years, the plantation would eventually fall victim

to poor growing conditions and rising labor costs, leaving as its legacy a few trees which may still be seen along the Hana highway.

Also in 1905, on the island of Oahu two structures were built which belong at exactly opposite poles of man's historical perspective of himself. At Kakaako, six brick-encased incinerators of the "Thackery Patent" were built, the complex being promptly dubbed a "garbage crematory". Meanwhile, Hawaii's developing sense of history led to the building of another brock structure, this one a "classic" in

architectural terminology of the day, and housing the archives.

The increasing energy requirements of a growing Honolulu dictated the building of a petroleum gas plant at Iwilei. Pipes were laid, and on June 3, 1905 all of the main streets in downtown Honolulu were lit by gas supplied from this plant. Manufacturing was by way of the "Lowe" high pressure system, from crude oil shipped in from fields in California.

In 1906 the Wahiawa Dam was completed on Oahu. The highest yet constructed in Hawaii, it measured 136 feet in height, was 461 feet long, and 580 feet thick at its base. It had required 141,000 cubic yards of fill and 26,000 cubic yards of stone backing, to form a reservoir 7 miles long, with a capacity of 2½ billion gallons. Built by the Waialua Agricultural Company at a cost of $300,000, the dam was designed by civil engineers L.G. Kellogg and H. C. Kellog. They were also construction superintendents for the project.

On June 11, 1906, the Kohala Ditch on the Big Island was officially dedicated by the wife of one of the island's most prominent ranchers, Mrs. Sam Parker. The latest in what was to be a long succesion of noteworthy agriculturally-oriented engineering projects, (many of which would evoke international acclaim), the ditch originated at an elevation of 1030 feet, tapping the Honokane Stream. It included

44 tunnels, the longest of which measured 2370 feet! The tunnels were a uniform 7 feet high, and were 6½ feet wide at the bottom and 8 feet wide at a height of 5 feet. Boring was an impressive and dangerous feat, with many openings becoming accessible only after workmen had carved hazardous trails out of the mountainside. Six men and as many mules were killed by falling down the steep precipices as the work progressed.

In the tunnels only the sturdiest of the Japanese workmen were selected, most succumbing after only a few week's labor in the cold and darkness. Many would emerge to long periods of hospital treatment.

Credited for the "undaunted foresight" which created the Kohala Ditch were Mr. and Mrs. Sam Parker, J.F. McCrosson and John Hind. The chief engineer was M.M. O'Shaughnessy, and the engineer in charge was P.W.P. Bluett.

It was also in 1906 that a fledgling new industry for Hawaii got off to a promising start, with the establishment of the Koa Lumber Mill on Hawaii, near the Volcano House. Capable of producing 250,000 board feet of lumber per month, the mill was connected to the volcano road by 3 miles of tramway. Koa was cut to be sent to San Francisco, while large quantities of durable ohia railroad ties were sent to the Atchinson, Topeka and Santa Fe Railroad.

In October of that year Mr. A. Gartley presented a technical paper before the Hawaiian Engineering Association which detailed construction of the hydro-electric plant of the Kauai Electric Company.

His attention to even the smallest facets of this project provide a wealth of information regarding turn-of-the-century water management, pipe laying and pole setting techniques, and describes the equipment used in the primitive stages of the manufacture of electricity. It also offers profound testimony to the dedication which was demanded of early designers and builders.

A paraphrase of a small part of Mr. Gartley's description follows:

The object of the promoters in building an electric plant has been to generate power from a mountain stream in Wainiha Valley on the northwest side of the Island of Kauai, and to utilize the same in operating pumps at McBryde Sugar Plantation on the south side of the island. It was estimated that about 2500 horse-power would be required. Preliminary surveys of the water, power-house sites, pole line, ditches, etc., were made in the latter part of 1904. Contracts were placed for conduit, power plant and transmission line in March of last year, and the plant was completed and formally opened early in August.

Wainiha is a deep valley which cuts into the heart of Mount Waialeale, and Wainiha stream is said to have the most constant flow of any stream in Kauai. When operations were commenced there were absolutely no facilities for receiving freight, housing workmen or transporting machinery. Thus it was necessary to build a wharf on the beach, and to connect it with trails to the power-house site.

The project called for water to be taken from the bed of the Wainiha stream to an elevation of 710 ft. then carried through a network of 32 tunnels and 8 connecting ditches having a fall of .2 per 100 ft.

The tunnels are 6 ft. wide and 4 ft. high, with an arched rise of 2 ft. They comprise 17,400 feet of the total length of the conduit. The ditches are 5 ft. at the bottom, 9 ft. at the top and 6 ft. deep with a 5 ft. berm. Their combined length is 5,600 ft. One large stream, the Maunahena stream, supplies a daily flow into the ditch of from 8 - 10 million gallons. Sand traps, spillways and flushing gates have been provided at several points along the line of the conduit and water is received at the lower end of the conduit into a forebay of substantial size and construction. The conduit ends in a tunnel dug

into the backbone of a mountain ridge. The fore-bay was excavated out of the solid earth to a total depth of 12 ft. It is lined with concrete 18 inches thick on the walls, and 6 inches thick on the bottom. There is a 42-inch sluice gate at its lower level and, immediately in front of this, and extending entirely across, there stands a wall 2½ ft. high, the object of which is to act as a baffle to retain the sand which might be precipitated. This wall also acts as a support for a screen which extends the entire width. Measuring 20 ft. long by 11 ft. high, this screen is made up of 3/16 x 3 inch flat iron bolted together and separated with pipe thimbles 3/4 inch long.

In the front of the fore-bay there are 42-inch outlets, connected with the pipelines, and closed by way of rising screw-stem wooden gates. Just outside of the fore-bay a riser pipe on each pipeline admits air when the valve is closed. A spillway 12 ft. wide has been provided on one side to take care of the rise in water which might be caused should the pipeline be suddenly shut off.

The pipelines lead from the fore-bay to the power house immediately below, a distance of some 1700 ft. The first section of pipe is 42 inches in diameter, tapering to 34 inches. The pipe thickness at

this point is 3/16". The 34" pipe extends for 880 ft. where it is reduced to 30 inches, its thickness increasing to 1/4 inch, and incrementally thereafter to 5/16" and 3/8".

The two pipelines are covered throughout their entire length, and are anchored in the trenches at intervals of 150 to 200 ft. There are 3 man-holes in the length of each pipe for access should stoppage or leakage occur. Since there are no air valves or relief valves, only a complete stoppage of the pipe, or a completed stoppage of the water wheel nozzles will cause an excessive strain.

The power house is a substantial iron building supported on a concrete wall. It includes a traveling crane of 16 tons capacity, carrying 2 eight-ton Yale & Towne blocks. This crane travels over the entire length of the power house, and has a capacity sufficient to lift any piece of its apparatus. The transformer house has an alleyway 11 ft. wide extending down through the center, and was designed with three entirely enclosed fire proof cells, each containing one transformer. It also is equipped with a traveling crane of sufficient capacity to handle the transformers. This building is constructed entirely of concrete with an iron roof. Its floor level is 6 inches below the level

of the main station, to prevent accident from fire should the transformer oil become ignited or boil over.

The station is equipped with two 1200 kilowatt generators directly connected to Pelton dual, disc-type water wheels, two 70-kilowatt exciters, a switch board and seven 500 K.V.A. transformers. Allowance was made for eventual installation of an additional 1200 kilowatt unit.

Each generator has a two bearing, double wheel unit, one pressed on each end of the generator shaft. Upon this shaft the rotor of the generator is mounted between the bearings of the wheel, the revolving element being carried in two water cooled, self-oiling bearings. These bearings, the water wheel housing and the generator are carried upon a massive cast iron bed frame rigidly secured with heavy anchor bolts to a concrete foundation. The wheel discs are heavy castings, carefully balanced and fitted with the necessary number and size of steel buckets to provide a combined maximum capacity of 2500 H.P. The buckets are cast semi-steel, and the shaft is of hollow forged nickel steel, 11 inches in diameter at the generator hub, and 9¼ inches in the bearing. The bearings are 9¼ inches in diameter, 30" long, and are of the ring oiling ball and socket type.

Water is brought to the wheels through heavy Y castings bolted to the flanged end of the pipeline. There are two water nozzles of the needle deflecting type to each main unit, mounted on cast iron sole plates and provided with forged steel trunion pins working in gun metal bearings. The latter have been packed with leather rings to prevent leakage when the position of the nozzle is changed. The nozzles themselves are provided with hydraulic counter-balances and are connected through levers and rocker shafts to an automatic governor. Tips of varying sizes have been furnished, and the quantity of water issuing from each is controlled by a bronze needle which centers accurately with the center of the nozzle tip. This bronze needle is mounted on the end of a steel shaft, and is operated with a hand wheel from the power house floor. The main generators are 1200 kilowatt, 2200 volt, 3 phase, 25 cycle, 375 r.p.m., rotating field, engine type machines built by the Westinghouse Electric and Manufacturing Company. They are extremely efficient, requiring only 15% greater current in the fields when operating at 90% power factor than when operating on a non-inductive load. The current is controlled from the generators to the transformers through a 6-panel blue VERMONT marble switchboard.

All the wiring from the generators to the switchboard and from the switchboard to the transformers is carried underground in 4" vitrified tile conduits.

After the current is stepped up to 33,000 volts, it leaves the transformer house and passes through two sets of high tension switches. This arrangement has been made so that the high tension current can be cut off from each bank of transformers. These two circuits are then united and carried to the main transmission line which is equipped with horn type lightning arresters which are tapped off the main line and which have dead legs which are carried to earth through a water resistance. A set of choke coils consisting of 24 turns of No. 0 bare copper wire coiled in the shape of a spiral upon a 10" circle with 1" cap are interposed in the main line between the lightning arresters and the main switches.

The line then goes through Hanalei Valley to the McBryde Sugar Company, passing over mountain ridges and through deep valleys for a distance of 35 miles. The poles are 30 ft. high, round cedar poles — with 10" butts and 7" tops, buried 6 ft. in the ground. The butts are protected by giving them two coats of crude oil before erection and

and again coating them at the ground line after erection.

The top-pins used on the line are made from specially selected eucalyptus stock which was air dried for 2 years before being used. These pins were turned up and than treated with a special parafine compound. Where long spans were made, and at bad corners, a special pin of wood, iron and porcelain was used. The pin was a 3/4 bolt with a special head and a thread to accomodate the insulator of wood. The base of this pin is porcelain.

The main line wire is seven stranded aluminum cable at 103,850 circular mills, equivalent in conductivity to No. 2 B & S, gauge copper wire. The use of aluminum wire on this line has been brought into question by some, but the concensus of opinion of those who have used aluminum wire is that no trouble should be experienced due to breaking down or crystallization. The cost of stringing it was less, on account of its weight, the joints were entirely satisfactory without the use of solder, and there is no appreciable disintergration of aluminum wire from ordinary atmospheric influence. A test started on the Pacific coast in 1900 near the sea coast has shown a deterioration of less than 4/10 of one per cent. The weight of the aluminum wire was only 47% of the weight of copper of the same length and resistance, while conductivity ranges

from 61% to 63% that of pure copper. The spans used on this line are mainly 130 to 140 ft., but in the mountain districts there are several spans over 300 ft., and a maximum span of 470 ft.

The construction of the pole line has presented many obstacles, and even the preliminary surveys were made with great difficulty. The line passes over high ridges between the valleys of Wainiha and Lumahai and between Lumahai and Waikoko, then across and through rice fields to Hanalei Valley. It is then carried up a ridge to an extensive table of land back of Kalihiwai to the mountain divide between Kalihiwai and Wailua. This section is through densely wooded country which is swampy under foot. It then passes along the divide and down the ridge to Wailua, along the base of the mountain range to a cap between Haiku and Lawai, then over plantation lands and across several gulches to Hanapepe. The trails which were cut, and roads and bridges built to enable the contractors to take in materials are permanent in character, to enable patrolmen on the line to keep the line constantly patrolled. Where streams were crossed a cable suspension has been erected, carrying a platform so arranged that patrolmen might cross.

At the McBryde end of the line, located at No. 2 pumping station,

is the receiving station of the high tension line. Here, there is one set of high tension switches, choke coils and lightning arresters similar to those at the power house. Four cells built of concrete contain the receiving transformers, which are connected in a bank of 3, delta to delta, with one transformer as a spare. The current is stepped down from 33,000 to 2200 volts. Drawing power from this line are two 500 HP motors, each connected to a two-stage high lift centrifugal pump of 5,000,000 U.S. gallons daily capacity against a head of 341 ft. operating at 735 RPM; one 500 HP motor, direct-connected to a two stage high life centrifugal pump of 6,500,000 U.S. gallons daily capacity against a head of 260 ft. operating a 735 RPM; and one 150 HP motor directly connected to a high lift centrifugal pump of 3,500,000 U.S. gallons daily capacity against a head of 168 ft.

The three first mentioned pumps were built by the Buffalo Steam Pump Works at Buffalo, New York, and the last by the Byron Jackson Machine Works, at San Francisco, All of the motors were supplied by the Westinghouse Electric & Manufacturing Company. Current is also taken to the mill, a distance of 3 miles from the receiving stations, and used there on small motors and for lighting.

The electric and hydraulic apparatus in the plant of the Kauai Electric Company is as high in efficiency as it is possible to obtain at this time. These efficiencies are rated as follows: Generator, 95.75%; step up transformers, 97½%; line, 92%; step down transformers, 97½%; 500 HP motors, 92%. Taking these efficiencies into account the amount of power which can actually be delivered to the motor shaft at McBryde Sugar Company 35 miles away, is 80% of the generator output, 77% of the power on the water sheel shaft and 61% of the theoretical power of the water. Accepting an efficiency of 76% for the pump the total water which can be delivered is 46% of the actual water flowing into the pipe line at Wainiha.

In 1907, on Oahu, it was discovered that the Nuuanu Dam was giving up its foundations. The City Fathers asked civil engineer H.C. Kellogg, (who had also worked on the Wahiawa Dam), to make an appraisal of the situation, and he reported that $50,000 would be needed to affect an adequate remedy. Sensing that Kellogg's estimate appeared conservative, the legislature summoned engineer J.D. Schuyler of San Francisco to give his views, resulting in an estimated figure of $132,000. The repair contract was ultimately awarded to L.M. Whitehouse for $123,445.

In 1908 The Hawaiian Pineapple Growers organized, "to secure greater economy and improvementnt in the methods of cultivating, packing and transporting the products thereof". Officers of the organization included J.D. Dole, W.H. Baird, T. H. Petrie, and D.B. Murdock. The considerable sum of $50,000 was appropriated for an advertising campaign, to be conducted under the management of James D. Dole.

That same year, Mckinley High School was built at a cost of $60,000. Located on Victoria Street, and facing Thomas Square, it was one of the first major structures in Hawaii to be built of hollow concrete blocks. Considerably different than their modern counterparts, these masonry units were designed to look like cut stone.

1908 was also to be a year of significant harbor development in Hawaii. On the Big Island bids were called for the Hilo Breakwater, a project for which $400,000 had been appropriated by the Congress in Washington. Considering Honolulu Harbor "too small", and "incapable of material enlargement", the Federal Government was hopeful that the project at Hilo would "establish a major marine facility for the United States in the North Pacific". Pearl Harbor was considered more appropriate for shallow-draft vessels.

Long an impediment to Hilo's growth and progress, its harbor was little more than an open roadstead, with large vessels "unable to lie at the wharves", because of heavy swells. Lacking any territorial appropriations for the purpose, the Olaa Sugar Company and the Hilo Railroad Company jointly undertook the task of securing Federal Funds. Having prepared the necessary supportive data, they sent a representative to Washington, eventually winning the approval of the Board of both the Army Engineers and the U.S. Congress.

Of the four bidders who submitted quotations, D.E. Metzger of Hilo was low, and was awarded the contract. Measuring over 9,000 feet in length, the breakwater had a uniform top width of 15 feet, and stood 11 feet above the low water mark. The majority of the stone was quarried from the Puna district, specifications calling for "a weight not less that 130-150 lbs. per square foot. and in sizes from

one to eight tons each". On October 27, 1908, the first large rock in the permanent work was lowered into place.

During this same year a breakwater was completed at Kahului, Maui. Built at private expense, the breakwater was reported to "afford Maui a safe anchorage for large vessels", which could now lie handier to the wharf.

On Oahu a contract in the amount of $410,000 was awarded by the War Department to the Hawaiian Dredging Company for improvements to Honolulu Harbor. The project included dredging the harbor seaward from deep water northward and westward of the channel, and between the channel and the quarantine wharf, thereby providing facilities for the largest ships. The basin of the harbor was also to be deepened to 35 feet, the material thus obtained to be used in building up an island some 700 feet wide, on which would be erected the front range light.

A government report of the day noted that Makapuu Lighthouse was nearly completed, lacking only its lens to be fully operational. Statistically the light stood 12 feet, 3 7/8 inches high, and had an 8 foot, 8 3/4 inch inside diameter. It weighed approximately 14 tons, and from the deck of a vessel could be seen for a distance of thirty miles

Newspaper reports of the day revealed that Queen Street, between Fort and Nuuanu was being paved with wooden blocks. Laid on a bed of concrete six inches thick, the blocks were covered with a thick coating of bitumen, and it was "hoped this technique would prove more durable for the heavy traffic of the waterfront than had been experienced heretofore".

In 1909 Honolulu had 45,000 inhabitants, among them 14,000 Hawaiians, 12,00 Japanese, 6,300 Chinese, 5,400 Portugese, 1,000 Koreans and 4,300 Americans, British and Germans. There were 1660 telephone subscribers, 360 licensed automobiles, 58 policemen and 29 licensed physicians. On January 4th the city held its first inauguration of a municipal government, as Joseph J. Fern took the oath of office as Mayor of Honolulu. His apprehension of the monumental tasks which lay ahead were no doubt magnified by the fact that he was a Democrat, and the seven man Board of Supervisors were, to a man, Republicans.

On October 21, 1909, another page in Hawaii's rapidly growing history of imported labor was turned when Messrs. A.L.C. Atkinson and A.W. Perelstrous, citing a "a need to augment Hawaii's labor force", arranged for the immigration of 50 families from Russia.

On December 31, 1910, at the Moanalua field of S.M. Damon, and

3,000 open-mouthed spectators, J.C. "Bud" Mars staged Hawaii's first aviation exhibition. He performed a "daring series of aeroplane flights", flying his bi-plane "Skylark", which had been designed and built by Tod Schriever. Veteran aviator Thomas Baldwin was the team's advisor.

Dredging work being performed as a part of the construction of Fort DeRussy was completed, and work on the fort itself was well underway. Massive concrete gun emplacements would hold 12 inch breech-loading mortars, designed to lob 1,000 pound shells onto the decks of enemy warships, thereby neutralizing the effects of side-mounted armor plating. Other military "hardware" of the day included a powerful sky-scanning searchlight system which was installed at Fort Ruger.

As work on the Hilo Breakwater neared the end of the first increment, bids were called for its second extension. The sum of $200,000 had been appropriated for this phase of the project, and the low bidder was the firm of Lord and Young.

It was reported that the Kahului Breakwater had suffered extensive damage in a January storm, with more than fifty feet of the structure having been washed away. Originally built with private funds, bids for repair work and improvements were now being under Federal control.

Nine months after its ground-breaking, Pacific Engineering Com-

pany was putting the finishing touches on the downtown Y.W.C.A. Designed by the architectural firm of Ripley and Reynolds, the 3 story reinforced concrete structure was built at a cost of $132,000.

On August 13, 1911, one Duke P. Kahanamoku of the Hui Nalu Surf Club set two amateur swimming records for the 50 and 100 yard events.

In January of 1912 the cornerstone of the College Of Hawaii was laid, at the same time that financial difficulties halted work on the downtown library. To the rescue of the latter came Andrew Carnegie, donating $100,000 to insure completion of the latter project.

Residential building activity centered in the Manoa, Kaimuki and Upper Nuuanu sections of Honolulu, with "bungalow" residences the preference of the day. In other parts of the city large numbers of group cottages, (usually referred to as "courts"), were built, often replacing outmoded and dilapidated two-story tenements.

In 1912 the third and final section of the Hilo breakwater was completed by the Philadelphia Breakwater Company. The contract cost was $450,000.

with its promise of Annexation, ~~which had assured~~ a stable government and a duty-free market in the United States, had stimulated immediate and remarkable expansion throughout the islands. One project which it had triggered, and which was not completed until 1913 was the Hilo-Hamakua Railroad.

The following data provides some idea of the character of the country that the line had to traverse, and of the magnitude of the engineering, construction and financial difficulties which were encountered in its building.

blah-blah-blah

In 1913 The Honolulu Iron Works Company erected a 4 story reinforced concrete building which almost totally covered its Queen Street block. The second largest building in the city, its cost was $175,000.

On Kauai, work was completed on the Kilauea Lighthouse. Standing 180 feet above sea level, it was reported that the light from its 250,000 candle-power revolving light could be seen for twenty miles at sea.

Answering the demands of increasing commerece, larger and larger vessels were calling at both Honolulu and Hilo, necessitating the further expansion of both of these harbor facilities. An aggregate bid was awarded to Hawaiian Dredging Company for $328,000. Hilo already had the distinction of having the largest and finest wharf in the Territory, measuring 1400 feet in length and accomodating 4 railroad tracks. Constructed by Lord and Young, it rested on a bed of solid fill, which had been obtained by dredging an adjacent reef.

Heralding a new era in communications, Hawaii first made radio contact with the mainland United States in September of 1914. Located at the base of Koko Head Crater, the Marconi wireless communications system received messages, while a sister station in Kahuku did all of the transmitting. Built at a cost of around $1,000,000, the two facilities were the largest of their kind in the world. D.L. MacKaye described the project as follows:

"Just as the cable and the telephone were the logical followers of the principle of telegraphy...there are things the 'wireless' will parent in the future world of mysterious essences. The future world of mechanical servants and magnificent ease remains to be seen. But here,(at Koko Head), is their foundation."

Construction of the formidable project was originally under the direction of Charles R. Guertler, who fell victim to a murderer's weapon before the task was completed. Ironically, it is recorded that a gentleman named N.L. Slaughter finished the assignment. According to his reports, the myriad difficulties encountered included "a dirt road which lies below the high-water mark, which is submerged more than one-half of the day, and over which trucks of five and ten tons of weight must traverse [illegible] the road leading from Kaimuki to Koko Head,

The year 1914 gave birth to the first County building in the Territory, a two story concrete structure built in Lihue, Kauai at a cost of

$60,000.

Libby, McNeill and Libby built the largest pineapple cannery in the islands, covering nearly four acres of land with a direct connectim to Oahu Railway. Its capacity was 250,000 cans per day.

An engineer named Jorgen Jorgensen began driving a tunnel into the backbone of Oahu's Koolau Mountain Range, as work began on the massive Wa$ahole irrigation project. Before he was done he would establish significant records in the annals of tunnel construction, and would be accorded international recognition. During the month of September, 1914, he drove the 8 foot by 7½foot face forward 655 feet, breaking all Hawaiian records and establishing a new mark for all America ! Significantly, the former record for one month progress was held by a California contractor, and had been set in soft limestone. Jorgensen's mark was established in a tough combination of lava and "kanaka rock", and in water conditions that ~~had to be~~ were reportded as being "some of the most difficult ever encountered in mining history". The miners had to inch their way forward through a racing flood of 66° water, flowing at a rate of 16 million gallons per day. For the last 300 feet the ~~tunne~~ tunnel was a whirling rainstorm, as water spouted from the sides, roof and face in continuous streams of such force that standing was often impossible. As the

airdrils bit into the lava, new streams developed, some so strong when changing drill-bits that one man could not drive new drill steel against them. Obviously, dynamite could not be tamped in the ordinary way, as the common dynamite stick was literally "torn up and spat out" by the flood. So tin cylinders, made to hold ten giant sticks of powder were prepared. The dynamite was unwrapped, jammed into the tins, fused and capped. Thus the cylinders could be driven into the drill holes, and wedged to hold against the rushing water.

Never in mining history had an attempt been made to drill a tunnel under such conditions! Merely moving equipment often seemed an insurmountable task. One writer of the day called the project an "underground riverbed".

At the completion of the project Jorgensen called for special tribute to the Japanese tunnel men, marvelling at their ability to withstand the hardships of darkness, bone-chilling torrents of water and ever-present danger.

The year 1915 heralded the start of construction of Oahu Prison, still in use at its lower Kalihi site. Designed by the firm of Ripley and Davis, the new prison was built by prison labor on 9.8 acres of land. An exception were the 24 maximum security cells, which were built by the Van Dorn Iron Works of Cleveland, Ohio, for the bid price of $22,408.49.

Designed to accomodate a total of 256 prisoners?, the reinforced concrete structure drew most of its raw material from the Wilson Quarry at Moiliili. It was noted that the entire facility had cost nearly one million dollars, its "grandeur" prompting the nickname, "The Kalihi Hotel". It was also reported that the ethnic preferences of the inmates required that three distinct lines be set up for every meal. They were the "haole line", the "rice line", and the "poi line".

Land was already becoming scarce in the "accesible lowlands", and cottages began springing up in Alewa and Pacific Heights.

The beginnings of World War 1 saw Hawaii prepared for whatever military emergencies might arise. By 1916 the Naval Station at Pearl Harbor was finished, with the exception of the drydock, which had been hampered by a long series of unforeseen accidents. Some $20,000,000 had been expended by the United States to make Pearl Harbor the model Navy Yard under the American flag. Nearby, and protecting the new station was Fort Kamehameha, which mounted huge mortar and rifled cannon? guns.

At Schofield Barracks 8 to 10,000 men could be billeted. At Fort Shafter, in Honolulu, a modern hospital was erected. Huge mortars were installed at Fort Ruger, at Diamond Head. Long lauded in song and story for its surf, sun and balmy moonlight nights, Waikiki's Fort DeRussy bristled with 14" guns, the largest ever placed in the Pacific.

The year 1916 would be host to a number of new road projects, including the one which circled Makiki-Roundtop and the long awaited Pali Road rebuilding. The latter would feature a brand new concrete surface and retaining walls to provide safety and endurance.

1916 also marked the demise of the last wooden structure in Honolulu's "business center", a two-story building located just off of Kaahumanu Street, and adjacent to a structure occupied by Schaefer and Company. The tallest of the city's buildings at the time it was erected, the structure had originally been three stories in height, and had been imported "in frame" by Captain James Makee in 1850. Erection had been accomplished by Richard Coady and Co., ship's chandlers and commision merchants, who were also the occupants of its second floor for a time. The first floor housed the auction room of John F. Colburn, and was later the home of The Chamber Of Commerce. The building was remodeled in 1873, with the first floor being removed and the remainig two floors lowered by means of jack-screws.

While agriculture was the economic byword of the day in Honolulu, the vast potential of its surrounding waters was also receiving increasing much attention. In 1917, with $5,000 in capitalization the Macfarlane Tuna Canning Co. was founded, and a plant constructed near the Union Feed Co,, on Ala Moana.

Military activity in the islands, which had been steadily increasing for several years, stepped up noticably with the outbreak of World War One. The bankers at Bishop and Co. announced that they had received their first shipment of 5,000 newly minted copper pennies, sorely needed to accomodate the newly instituted war tax.

Among the military building projects underway in 1918 were the island's first airplane aeroplane hangars, located on Ford Island. That same year marked saw the death of Mark B. Grace, a pilot with the 6th aero squadron at Fort Kamehameha, and Hawaii's first recorded aircraft fatality. Miraculously, his companion, Cary Crowdes survived the 3500 foot fall, escaping with only minor injuries.

On August 21, 1919, the much-delayed drydock at Pearl Harbor was succesfully put into operation. This was in marked contrast to the first attempt in February, 1913, when the following report had been filed:

"The final attempt to unwater the cofferdam resulted in a disaster that shattered all hopes. The pumps were kept at work for 11 days,

the water gradually lowered, and the timberwork showed increasing signs of distress as the work proceeded. At 10 a.m., February 17, the cribbing begab to rise at an alarming rate from the tremendous hydrostatic pressure below, and the pumps were stopped at 2 p.m. From that hour the engineers, naval officers and workmen could only stand aside and watch the fruits of 4 years labor and millions of dollars crushed into a shapeless mass."

Fortunately, no lives were lost in the incident, and an investigation was begun immediately. Eminent geologists and engineers were called in for consultation, one popular theory being that volcanic and coral formations made anything except but a floating drydock unfeasible. There were differing opinions from among the many eminent authorities involved, but the projected costs of a floating drydock were so prohibitive, and the need for some kind of facility so great, that it was finally decided that another attempt should be made at constructing a permanent installation.

Engineer Alfred Noble, past president of the American Society of Civl Engineers, and a professional held in high regard by his peers was named Consulting Engineer. After numerous conferences, which were attended by Admiral Winterhalter, Chief of Material, and bu civil engi-

neers Stanford and Mead fo the Bureau of Yards and Docks, the final recommendations of Mr. Noble were received. His proposal called for a design and a method of construction, both of which represented a marked departure from the engineering norm of the day.

The succes of his theories was ably demonstrated when the entire drydock was pumped dry for the first time in early March. So nicely had the weight of the materials been balanced against the pressures of hydrostatic lift, that the dock rose a mere 3/16 of an inch when completely dry.

Total appropriations for the project had been a staggering $5,000,000. Work had been under the engineering supervision of the Bureau of Yards and Docks, with Rear Admiral C.W. Parks named as officer in charge. He was later succeeded by G.A. McKay of the Civil Engineer Corps. Contractor for the project, both through its failure and continuing to the time of its succesful conclusion was the San Francisco Bridge Company.

In 1919, the combination of critically short materials coupled with a growing land shortage prompted the introduction of Honolulu's first duplex houses. Referred to as "double apartment houses", they first began to appear in the popular residential areas of Manoa and Waikiki.

Increasing amounts of attention were being paid to the fledgling fishing industry, and an appropriation of $130,000 was voted to develop

Kewalo Basin as an anchorage for the fishing fleet, and for other small craft.

In Hana, on the island of Maui, $95,000 was appropriated for the building of a pier.

On November 27, 1919, elaborate ceremonies marked the dedication of the new Mormon Temple at Laie, Oahu. Its construction cost was reported to be in excess of $200,000.

~~where oh where does insert g go~~?