

PROF. WILLIAM DeWITT ALEXANDER.
Surveyor-General, 1871—1901

A HISTORY

OF THE

Hawaiian Government Survey

WITH NOTES ON

LAND MATTERS IN HAWAII

By CURTIS J. LYONS, ASSISTANT

Appendixes 3 and 4 of Surveyor's Report for 1902

HONOLULU:

PRINTED BY THE HAWAIIAN GAZETTE CO.

1903.

42-1427

Hawn.
GA87
H3L9

APPENDIX NO. 3.—THE HISTORY OF THE HAWAII
AN GOVERNMENT SURVEY.

The Government Survey of Hawaii has derived its main importance from its relation to the original land titles and to the public land system of the group. It owes its origin to the necessity of such a survey to the Government in dealing with its own lands. But as an organization it has been indispensable in many other lines, and has ever been hand in hand with all schemes for the development of the country, and has also had its share in the scientific work of the world.

To understand its inception and its legitimate objects, it will be necessary to dwell, briefly if possible, upon the land history and land conditions in Hawaii, and to repeat for the benefit of readers abroad many things already known to residents on the islands.

Civilization came to these islands to find an already existing land system, such as it was. What might be called "no man's land" did not exist here, and the peculiarly American term "taking up" land has practically no place here. The land was "taken up" probably a thousand years or more ago. The "ahupuaa" may be regarded as the primary division of Hawaiian land. Its typical form was a strip at right angles to the shore, with its fishery and sea beach, its cultivatable

land, and higher up, its forest. All with definite boundaries, and each with its specific name. A chief held it; not owned it, for he owed allegiance to a higher chief or the sovereign. He himself, in turn, had tenants beneath him, occupying with more or less permanence, owing him military service in time of war, and agriculture service in time of peace.

The sovereign therefore "owned" all; he dared not dispose his powerful tenants for fear of rebellion; but no one could give such a fee simple title as civilization demanded.

A general division took place in 1846-1849 under Kamehameha III. The methods will not be given here, but the results were as follows:—

1. The king owned certain reserved lands, treated at first as private property, afterwards, in 1864, by Act of Legislature, signed of course by the then reigning king, heir of Kamehameha III., made inalienable public property known as "Crown Lands," whose revenues should ever thereafter go to the reigning sovereign's emolument.

2. The chiefs owned in fee simple the better portion of the lands formerly held by them in fief. Excepting however the kuleanas to be mentioned below.

3. Lands that were set aside to be "Government Lands," mostly such as were given up by the chiefs in order to acquire the complete title to those specified in No. 2.

4. "*Kuleanas.*" Kuleana is a Hawaiian word originally signifying an interest in either property or business enterprise schemes. It came in the time of the Land Commission to be applied universally to the fee simple holdings awarded to the common people. That is: in all the three classes of lands mentioned above, the sub-tenants were allowed in fee simple such separate small tracts within the limits of the ahupuaa as they had previously improved or lived upon. There were about 11,000 of these titles, many of them covering two or more separate lots.

5. After the lands mentioned in No. 3 above were set aside, portions of them were sold to individuals at what was really a nominal figure, generally to native inhabitants of the lands, or to foreigners who had already made their home in

the country. These were covered by Royal Patents which are now called *Grants*. At the inception of the Government Survey there were about 3,000 of these.

A rough estimate would give about 2,000 Ahupuaas in the group. Many of these have subdivisions termed "*Ilis*." The "*ili*" often had a different owner from that of the ahupuaa in which it was situated.

We have therefore Crown Lands, Chiefs' Lands, Government Lands, Kuleanas and Grants. The initials L. C. A., Land Commission Award, apply to all lands, kuleanas or ahupuaas, or "*ilis*," which were awarded by the Land Commission between 1848 and 1855. These are the main features of the land system, many details of which are omitted here for lack of space.

Now as to boundaries. The Kuleanas were awarded and the Grants were all made by surveyed descriptions incorporated in the titles given. These surveys were all magnetic surveys, and were made each on its own basis, giving generally the names of adjacent owners or of adjacent Ahupuaas and *ilis*. Practically there were absolutely no general surveys, although there were a few sections where the kuleanas were plotted together in their relations to each other.

For the sake of getting a speedy issue of titles it was necessary to make the surveys as cheaply as possible. Men of intelligence and capacity able to measure around a lot with compass and chain were employed to survey the kuleanas at two or three dollars a claim, also two or three professional surveyors. There were no workmen competent to make general surveys nor means to pay such workmen. The boundaries of the ahupuaas were often very crooked and irregular, in many cases, gulches.

Some of the chiefs had their lands surveyed and received awards by survey, but the majority of the ahupuaas were awarded simply by name, with the understanding that ancient boundaries should be preserved. Some were surveyed after award.

The consequence of all this was that about 1868-1870 when there was a demand for additional grants of land, the Gov-

ernment was paralyzed by an absolute ignorance of the location and amount of what was left available. The lack of maps was also apparent in other directions.

The Government was in the habit of paying a small annual stipend (\$400) to a native surveyor who was acquainted with the lands around Honolulu, who rendered assistance when wanted. In the Legislative Session of 1868, a member who had not then the slightest personal interest in the matter, (the writer of this article) moved that the appropriation be increased to \$3,000 for the two years for the purpose of beginning a general survey. The amount was voted, but nothing was done about it in that biennial period. But the idea took root in the mind of the then Minister of the Interior, Dr. Ferdinand W. Hutchinson, who had by law the care of the public lands, and who had authority by the wording of the law to have them surveyed when necessary. Minister Hutchinson accordingly asked the Legislature of 1870 for \$5,000 for "Government Surveying" for the Biennial Period, which was granted. In the course of the year he appointed William D. Alexander, then president of Oahu College, Surveyor-General. Professor Alexander had, during the year, executed a number of surveys on the Island of Maui, including that of the crater of Haleakala, which latter survey is well known, and being a thoroughly educated man was in touch with scientists abroad. The aforesaid writer of this article was taken as assistant, having had experience in Kuleana, Grant and Ahupuaa surveying in the time of the Land Commission. When the work began in 1871 two young men just out of Oahu College, J. F. Brown and J. M. Lydgate were taken on the staff.

The primary object of the Survey therefore was to account for all the land in the Kingdom by its original title, and indicate such accounting on general maps, and while having no authority to settle boundaries, to require the surveyors to lay down such boundaries on maps to the best of their ability with the abundant information at their disposal. This was the only means of enabling the Government to know what it possessed. The subsequent history of the country has shown

the wisdom of the course, and the fact that these maps, free as they have been to consultation by the public, have been of infinite use to the said public, is the reason why money has always been forthcoming from the public revenues.

To accomplish the object several things were necessary. First, to execute such a triangulation of the country as is now well known to be the foundation of every good general survey, furnishing points by which to connect together correctly all work, whether cadastral or boundary work; also topographical work, hydrographic work and engineering work. To make a reliable, or in any way general map by patching together a number of individual title maps is simply impossible.

Second, to put in the amount of topography necessary to identify localities and land limits.

Third, to copy in shape for practical use the individual kuleana surveys of each district to be surveyed, also the surveys of Grants. These were indiscriminately contained in large volumes, and were only to be found by means of indexes. It was necessary for a party going into a district to have for use a book containing all the kuleana surveys of said district, arranged according to lands, another containing all Grants, and another still of Ahupuaas or ilis that had been surveyed. It was the task to fit these in place by means of the controlling triangulation. This would practically show the location and limits of Government lands remaining.

While the old "spot surveys" had served their purpose of enabling titles to be acquired, and while the majority of them had been made by conscientious and intelligent men, still the crudeness of cheap work, and the faulty methods, and the lack of uniformity, made the task of locating these surveys in proper places a difficult one. It is true also that there had been two or three Land Commission and Government sale employees who were outrageously incompetent, and whose work has made an infinite amount of trouble.

The logical order of conducting a survey of the character of this, the newly established one, would be as follows:—

First, to establish the exact latitude and longitude of an initial station.

Second, to measure a base-line or lines, and extend from such base or bases a chain and net-work of primary stations over the whole group, forming one system. (It must be borne in mind that the base-line of a triangulation has nothing in common with the base-lines of the United States national public land system). To illustrate, on the island of Oahu, Diamond Head, Punchbowl Hill, Tantalus, and Konahuanui and Makapuu Pt. are all primary stations. They form a part of a chain of consecutively established points, which extends not only around this island, but also continues through the group to Hawaii. They are primary in relation to the work here, but correspond in scale and accuracy of determination with secondary points on the mainland. They are all established by their latitudes and longitudes down to a single foot, and also by their exact distance and direction from each other.

The next step logically is to establish secondary stations dependent on these, in groups surrounding these, and generally recorded by northing and southing, easting and westing from a near primary station.

Next in order is to survey the land topographically, starting the work from these stations as a sub-frame work, entering especially coast lines, roads, hills, gulches, fences, houses, monuments and any other object likely to be useful in locating land boundaries.

Lastly, to take up the old title surveys, establish some of the corners on the ground and fit them in on the map to the best of the ability of the surveyor in charge, which last means a great deal. Good judgment and experience on the part of the surveyor in this means far more than technical skill, and then later on the work should be subjected to the opinion of the best expert in the office.

The boundaries of the Government Tracts should then be thoroughly delimited along lines of private ownership.

This ideal programme, however, is very unlikely of fulfillment. It is always necessary, in matters of this kind, not

only to placate the public by producing maps at an early date, but to meet real needs of public business.

The newly appointed Surveyor-General placed himself in communication with the U. S. Coast Survey. The officers of this bureau were extremely courteous, and loaned to the Hawaiian Survey a high class base-line apparatus and other instruments. The methods of the Coast Survey, also of the British Ordinance Survey, the Great Indian Survey and the Australian and New Zealand Surveys were studied for suggestive guidance in this work.

It was decided for various reasons to begin work on the island of Maui. Accordingly after some time spent in selecting a level site for base-line, a number of stations for triangulation were established, including the summit of Haleakala and also that of Kahoolawe Island. The actual measurement of the four-mile base was begun on the 18th of August, 1871. It was located on the Maui Isthmus and extended from near Kahului towards Maalaea Bay. The apparatus consisted of two four-metre bars of iron enclosed in pine scantling, supported by tripods, and furnished with thermometers to determine the temperature correction, and with graduated levels to determine the slope correction for each bar setting. It may be noted that while the 4-mile line was probably correctly measured within an inch, the temperature correction alone amounted to about seven feet. It was a slow and tedious job, the "contracts" being made with a magnifier and the bars lined in with a transit, the whole field work requiring three weeks, the services of four skilled men and three or four laborers. The "bar" method has been superseded in later years by the use of 200 or 300-foot steel tapes, this method however being only successful in cloudy weather on account of unequal heating of the tape by the sun in clear weather. Calm weather is also essential for tape work.

The justification for the expense of measuring a base line with such extreme accuracy lies in the fact that it is done once for all, and the exact length is likely to be required in after years, not only for the ordinary needs of boundary

work, but for the most critical demands of science and of engineering.

To explain the bearing of this statement it is necessary to explain the meaning of the term triangulation. In this method of work after the exact length of a base-line is determined, its ends of course being visible from each other, the elevation of each extremity above the mean sea-level, the exact direction (azimuth) of one end from the other, and the exact latitude and longitude of each end are all ascertained. A prominent point is then selected, generally on a hill top, whose exact direction from each end of the base is ascertained, and the exact angle that this direction makes with the base-line. The distance of the precise point of intersection of these two lines of direction can be calculated. This calculation not only determines the position of the new point but furnishes two new base lines, so to say, with which to determine by the same method other points beyond. Thus the chain of points goes on and it is needless to say that the correctness of the whole work depends upon that of the base-line measurement.

During the winter of 1871-72 this triangulation was carried on over the central portion of Maui. A fine 12-inch theodolite by Troughton & Simms of London, reading to seconds of arc, arrived meanwhile, and has been the mainstay of this character of work ever since. The work for the season extended to the summit of Haleakala, whose height was then ascertained, and to the highest hill on Kahoolawe.

It was then decided to make a detailed survey of a district in order to exhibit to the coming Legislature the scope of the work, as well as to gain experience and establish precedents in what was then an untried undertaking. Accordingly Makawao with the neighboring region was selected, and the whole force was employed there from March till June, 1872, the map which was also drawn there being the pioneer map of the Survey. A sketch map showing all the executed and projected primary triangulation of Maui, Lanai, Molokai and Kahoolawe was also made, and the great errors

of the existing chart of Maui, shortening the island about ten miles were demonstrated.

Returning to Honolulu, the entire party in the early fall took up the matter of an Oahu base-line. For convenience this was chosen nearly along the Northeast line of King Street from a point east of Thomas Square out to the slight rise near the Moiliili Church, being something over 10,000 feet in length, and at that time over an entirely open country. The measurement occupied about two weeks, a portion being re-measured in order to judge of the accuracy of the whole, which was deemed to be within about one in 250,000 of the actual length. That is to say, the probable error was deemed to be not more than a third of an inch.

In connection with this base a series of exact levels were run from the foot of Nuuanu Street where an assumed mean sea-level was taken, out to the base-line and over its entire length. A bench-mark established on this line of levels on the front of the present Judiciary Building has been the standard of all city work ever since. Another necessary step was the ascertaining of the exact azimuth or angle made with the true meridian by the base-line. This determination harmonized within two seconds of arc with the meridian by the Transit of Venus party of 1874.

The triangulation of South Oahu was immediately taken up, Tantalus, Diamond Head and other points around by Mokapu Point in Kaneohe being observed on and the positions calculated. As the east end of the Oahu base-line has been lost, the distance between the Tantalus and Diamond Head Stations may be said to remain as the standard for length for all work on the island. The heights of all these points were carefully ascertained.

The next step in the winter of 1872-73 was to measure a base-line for the Island of Hawaii. This was located on the Puukapu plain in Waimea, 2,800 feet above the sea, and about 13,000 feet in length. The triangulation in the neighboring region executed at that time extended to the summits of Mauna Kea and Hualalai and to Puu Loa above Kawaihae. A line of levels also connected the Hawaii base with the sea.

The foundation was now laid for the work in the three greater divisions of the group.

The party then returned to Honolulu, with the exception of Mr. Brown, who entered upon private work. The matter of cession of Puuloa or Pearl Harbor to the United States had just come up for action and a survey was ordered. The main triangulation was extended to that part of the island, secondary triangles for the harbor measured, and the shore lines run in with great care by the plane table, making a basic map of said harbor which has been the foundation of all the later work. The U. S. Coast Survey experts, Lieuts. Sands, Cutting and Wilson, executed the soundings for the bar; the map was completed in June, 1873. Mr. Lydgate left the survey at this time to enter upon private work on Crown Land and other boundaries on Hawaii.

The work of compilation of lists of lands giving titles and location, now devolved upon the Surveyor-General, and the results have always made this office a source of information.

During the period 1873-77, the following objects were attained:—By Professor Alexander, the triangulation of the Island of Oahu was completed, the whole of Wai-anae and Central Oahu surveyed; the country between Honolulu and Manoa known as the Makiki District was surveyed, and, as mentioned above, lists of lands and titles perfected. Oahu was connected to Molokai by heliograph triangles, and longitudes and azimuths were compared by the data furnished by the British Transit of Venus expedition which came to Honolulu in the winter of 1874-75. By C. J. Lyons, coast line surveyed from Waialae to beyond Pearl Harbor, also the upper part of Nuuanu Valley; the first general map of the group since the days of Commodore Wilkes was compiled from all sources of information at hand, a finished copy of this being sent to the Philadelphia Centennial. The map was also published by the Board of Education as a wall map. A map was also made of the Island of Oahu on the scale of 5,000 feet or nearly a mile to the inch. This, too, was dated 1876. Unfortunately it was not published in first-class form. These maps showed the

previous charts to be quite incorrect in outline. There was the Cook-Vancouver map, then the "Mission Map" published at Lahainaluna in 1836, which is very valuable as being made with assistance of Hawaiians, and so preserving correctly the old names, and the Wilkes Expedition Map of 1841. Each had its own excellencies and errors, the last mentioned being no better than the others, and having some parts of coast line ten miles out of position.

In 1876 a detailed survey of Kaneohe was executed by Mr. Lyons, the question of Crown and Government Ilis inside of an ahupuaa that had been awarded by name coming up in this connection, and being ultimately referred to the Supreme Court for decision. It is almost needless but important to say that the Court accepted the existence of such titles within titles, as a part of the system as handed down.

In 1877 a renewed period of activity was inaugurated. Taking Mr. F. S. Dodge as assistant, Prof. Alexander not only carried out the triangulation of the larger portion of East Maui, but executed the detail maps of the districts on East Maui known as Hamakualoa, Koolau and Hana, all rough districts with rugged coast-line, and including Haleakala Mountain. At the same time Mr. Lyons took up the survey of North Hawaii, co-operating with Professor Alexander in connecting by heliograph the triangulation of North Hawaii with that of Maui, by means of the stations Haleakala on Maui, Moaula on Kahoolawe, Puuloa and Puako on Hawaii, the nearest distance being about 68 miles. The Hawaii triangulation was then carried from Puuloa near Kawaihae to Hilo, over Mauna Kea and through Hamakua and Hilo districts. A general reconnaissance of boundaries in South Kohala, Hamakua and Hilo, including the Mauna Kea and Mauna Loa regions were made, and the entire Hilo coast-line and road-line surveyed. This party returned to Honolulu in 1878. Mr. J. S. Emerson joined the Survey at that time and in 1880-81 executed a detailed survey of the valley of Waipio, Hawaii, which involved a large amount of work on account of the titles to kuleanas, and of Ilis that were not a part of the main title. Mr. S. E. Bishop, a good mathematical schol-

ar and previously principal of Lahainaluna High School, undertook in 1880-81 the survey of Waikiki, i. e., the district between Honolulu and Diamond Head. As there are about six hundred different kuleana lots, with numerous Grants and Ilis, and as proximity to the town of Honolulu necessitated careful work, this was a tedious job, but the results have been absolutely indispensable to public as well as private interests. In all work of this kind the method has been followed of mapping all natural and artificial features and fitting in the old surveys, all on the basis of triangulation.

During 1878 a compiled map of the Island of Kauai was made by Mr. C. S. Kittredge. A large portion of the Ahupuaas had been surveyed as to their external boundaries, for settlement of such boundaries. With the "control" of what may be termed a reconnaissance triangulation executed by Mr. J. F. Brown, a map on a 5,000 foot to the inch scale was secured, which has done good service. On account of the small amount of the then Government land remaining on Kauai, and of the fact that the Island is more entirely taken in hand by the owners, notably plantation people, there has not been the need of Government survey work there which there has been on the other islands.

During this period Professor Alexander completed the triangulation of the Maui group, connecting Maui, Lanai and Molokai with Oahu. A good deal of work was done adjusting large land surveys in Hilo. Mr. Lydgate returned to the Government Survey work and carried out the general survey of Hamakua and Kohala districts on Hawaii. Mr. W. A. Wall, becoming a pupil in the Survey Office was soon capable of undertaking a draughtsman's work, and based on the work of Messrs. Lyons and Lydgate, produced under superintendence a series of maps extending from Hilo Town through Hilo, and all the Hamakua and South Kohala districts, mostly on a uniform scale of 1,000 feet to the inch, which have been of inestimable use in the development of the sugar industry and later of the homestead enterprise in that section.

Mr. J. S. Emerson, in 1882, undertook the triangulation of the west section of Hawaii from Kawaihae southward, and

it may be said in advance that he has borne the entire responsibility of that arduous country, taking in Mt. Hualalai and Mauna Loa, and around through the districts of Kau and Puna, completing with the supplementary assistance of a section by M. D. Monsarrat, in E. Kau and of E. D. Baldwin's work near Hilo and in Puna, the entire circuit of triangles around the island. This circuit includes of course the work already done in North Hawaii. The lands in Kona and Kau were located, the Grants mostly plotted in on a 2,000 foot scale, all the main features of the coast were put in, although the detail which would be possible with a 500 feet to the inch scale was not undertaken.

Mr. S. E. Bishop, in 1883, carried a minor triangulation around the northern part of West Maui and surveyed in detail the entire coast, putting in the land intersections and a good deal of topography. The Island of Lanai was surveyed in 1877-78 by Messrs. J. F. Brown and M. D. Monsarrat, and a map of it made on a scale of 2,000 feet to the inch.

Mr. M. D. Monsarrat was employed to take in hand the entire Island of Molokai. This survey was taken up in 1885 and continued at intervals till the year 1895 saw the work completed. A series of maps was made on the scales of 1,000 and 500 feet to the inch, covering the whole island, excepting the west peninsula, this latter portion being drawn on a scale of 2,000 feet to the inch.

The district of Kula, Maui, had been previously surveyed by Professor Alexander and M. D. Monsarrat in 1880. Honoua'ula and neighborhood was surveyed partly by F. S. Dodge, and the remainder in 1883 by E. D. Baldwin, who had, as it were, grown up in the survey and had also surveyed Manoa Valley, a very minutely sub-divided tract near Honolulu. A heavy undertaking was the survey of Lahaina district in Maui, by S. E. Bishop, the map exhibiting a labyrinth of lines equal to any in existence.

In 1890 then the area of the whole group had been pretty well elaborated on paper, and information was ready for all inquirers. It is of course impossible in this article to give more details than the above.

The general map of the Island of Maui was executed by F. S. Dodge in 1885, and was published in good style by Julius Bien, of New York, scale 1.60000, or 5,000 feet to the inch.

The work of the Survey during the decade just passed, 1890-1900 has been very largely surveys of homestead tracts, and other public land sub-divisions, re-surveys of tracts that needed much more minute work than was at first possible, and the carrying out of a very important department of work, viz.: the city survey of Honolulu.

This last began in 1880 with a traverse of all the then streets by Professor Alexander. Then, beginning in 1881, Mr. J. F. Brown made block surveys showing principal sub-divisions and titles. Then about 1884 the present system of what is known as "rectangular co-ordinate surveying" of the city was adopted, and was carried out mostly by Mr. F. S. Dodge and later by W. E. Wall. The triangulation station on Punchbowl Hill (in the city) was taken as a centre in the same way that the intersection of the Greenwich Meridian and the Equator are taken in Geography, and all points in town and in the harbor, and on the bar have been referred to it by northing and southing, easting and westing, giving an absolute as well as relative location. The same method is now used in country districts, taking a neighboring important "trig." station as a centre in each case, which point is termed the "origin of co-ordinates" for that district. A minor triangulation of great accuracy, based upon the primary triangulation controlled the entire city and harbor, giving a complete check for traverses.

New maps on the scale of 20 feet to the inch were made of the business and central portions of the town, showing every building, and by colors the limits of the original awards, which were generally very irregular. The streets in the older part of the city, it should be remarked here, were not "laid out" strictly speaking. They were simply put through a village mostly of grass huts before there was a surveyor on the islands. When the surveys for titles were made each lot was surveyed just as fenced, without any attempt to rectify street lines, which in fact did not exist. This fact will explain much

about these matters, which later comers may not understand.

This city work mostly carried on by Mr. W. E. Wall, or under his supervision, has taken much of the time of the Survey during the past few years on account of the rapid extension of city improvements, and of the number and variety of land exchanges and transfers necessary on the part of the Government. Honolulu is probably as thoroughly surveyed a city as one will often find.

The Survey has been the main stand-by in all matters of scientific precision. Very shortly after its inception, enough tide measurements were made with a home-made tide gauge to determine the general law of the tides, and in 1880 a self-registering tide-gauge was loaned by the U. S. Coast Survey, which was set up in Honolulu Harbor and kept record for some years. A more modern instrument by Hugo Bilgram was procured and set up in a thorough-going style in 1891. From its record the tide predictions of the Coast Survey Tables are derived, careful records are made of the changes in mean sea level, and any earthquake waves or other deep sea disturbances that come to these shores are noted.

In 1882 the bureau took charge of the Government time for the town, with the equipment of the 12-inch theodolite and a chronometer. In 1886 a Molyneux astronomical clock and an astronomical transit, both of which were brought to Honolulu in 1846, imported at that time by G. H. Boardman for regulating chronometers, principally for the whaling fleet, were purchased by the Survey, and an observatory for time purposes was established, since which period all time determinations have emanated from the Survey Office. Chronometers have been rated in default of any private practitioner in the business up to a late date.

In 1885 advantage was taken of the fine chronometers of the steamers *Mariposa* and *Alameda*, on repeated round trips, to compare time with the Coast Survey time at San Francisco. The result practically agreed with that of the work of the British and French astronomers, Tupman and Fleuriais, and Honolulu has thus been made a standard port for the Pacific Ocean. In February, 1896, standard time was established

here, based on the meridian of 10 hours, 30 minutes slow of Greenwich ($157^{\circ} 30'$), which meridian is central to the group. This was proposed here and was accepted by the U. S. Coast Survey.

Professor Alexander, in 1884, represented Hawaii in the International Conference at Washington, which adopted Greenwich as the initial point of longitude.

A Meteorological service gradually grew into existence in 1882 and succeeding years, in 1900 initiating regular rainfall reports, and which is acting in conjunction with Meteorological work abroad.

The necessity of a latitude standard for the group was soon apparent in the course of the Survey. For instance, the latitudes deduced from observation of stars at the north end and at the south end of an island would be found to differ from each other by a fixed amount, say ten miles. But by actual measurement, triangulated, the difference would be say half a mile less. The error of the first difference is owing to the plumb-line, or which is the same thing, the spirit in a spirit-level, being attracted by the mass of the mountain between the two stations, which fact affects the observed altitude of the sun or star from which the latitude is determined. This "deflection of the vertical" is particularly large on these islands.

Professor E. D. Preston of the U. S. Coast Survey was invited to assist in this as well as other lines of research. Three different visits by this assiduous scientist in 1883, 1887, 1892, were devoted to latitude observations, pendulum observations for determining the force of gravity, and to magnetic observations for declination, dip, and force of magnetism. With Prof. Alexander and Mr. W. E. Wall, the ascent was made of Haleakala and Mauna Kea, and these and many other stations were occupied on this work. As the work of the Survey is done upon a true meridian, the comparison of this with the magnetic bearings at hundreds of stations had already given the magnetic declination and annual change, but a standard character was given to the matter by this work, and a basis for future comparison. The average dis-

placement of the vertical at the coast of the larger islands was found to be nearly half a minute, which would cause nearly half a mile of error in either latitude or longitude as the case might be, and also affects nearly all altitudes of our mountains.

The office work of the Survey has consisted, besides the making of maps by the assistants, who have executed the field work, of the arranging and general organizing of all records, which are very numerous and of many kinds, and of the searching for and giving information of all kinds to inquiring parties. These are landowners, prospective purchasers, private surveyors and departments of government, principally the Interior Office, now Public Works. Also the giving of assistance generally within the scope of the bureau, which is, as has been seen, has been a wide one. It has been so that the humblest holder of a kuleana from any part of the group could be freely informed on questions pertaining to his lines and original titles. No charge has been made for this. Visitors from abroad have been numerous, many of them in high scientific positions, navigators and navy officers of all grades being frequent callers. The systematizing of field notes and calculations, and giving uniformity to map work has been an important matter.

Mr. Lyons was in charge of the office from 1879 to 1896, and with increasing years is now mostly content with meteorological work. Mr. F. S. Dodge has probably produced the greatest number of elegant maps, but comparisons in this matter would be invidious.

The Survey has never been in a position to enter extensively into the very interesting hydrographic work that surrounds this group of islands. But from 1881 to 1884, Captain George E. Gresley Jackson, holding the position in the British Navy of Navigating Lieutenant, retired, was employed to survey the different harbors of the group. Having had experience in Marine Surveying these maps are as full and accurate as was consistent with the means at disposal, and have been very useful. There are about twenty-five of the series, and

most of them have been published by the U. S. Hydrographic Office.

There are now over 2,000 maps on file in this office. Many are old maps of historical value as well as legal. Survey maps proper vary from a plot of a section of a street to district maps involving thousands of dollars worth of work in the production. The standard sizes of survey maps (when rules are observed) are 28 x 36 and 36 x 58 inches. The usual scales are on the one, two and five divisions, i. e., 20, 50, 100, 200, 500, and 1,000, and so on feet to the inch. It has been deemed best to keep in touch with the average intelligent mind in the matter. For the same reason the unit of measurement has been the foot. After due consideration it was decided at the outset not to use the metre except in the base-line measurement, and experience has shown the wisdom of the decision. The reduction of chains and links on the old surveys to feet has been a burden, but one cheerfully borne. No Magnetic lines have been allowed in new work, all being referred to the true meridian. But the work of putting in old magnetic lines of infinite number and crookedness has been hereculean.

Mr. E. D. Baldwin, after producing a fine map of Honolulu, surveying the districts of Kipahulu and Kaupo on Maui, also a number of homestead tracts on Maui, was detailed to take charge of all work in Hilo Town and Puna district, and has remained in that capacity for over ten years.

Mr. J. F. Brown left the Survey in 1886 to take charge of the public lands, and remained in that department up to 1901.

Mr. F. S. Dodge, after carrying the heaviest part of the city surveying for a long period, resigned in 1899 to take charge of the Bishop Estate lands.

Of later workmen, Mr. S. M. Kananui, a full-blooded Hawaiian, has executed a large amount of first-class detail work in field and office, and also has accomplished a good deal in reduction and compilation of maps, notably in North Kohala.

Christopher J. Willis, of partly Hawaiian descent, learned in the office, and became an accomplished draughtsman. Of his work the present published map of Molokai is a good specimen.

Mr. O. L. Sorenson, after working for some time in the Public Lands Office, came into the Survey Office in 1898, and has been mostly employed on city work, and is now assistant in charge of office.

A great deal of valuable material has been obtained by men trained in the office and familiar with Government Survey methods, who, leaving the office, have been employed by plantation owners and other large land owners to make detailed maps, copies of which have generally been freely furnished to the Survey.

The first published Survey map of the Island of Hawaii was drawn by W. A. Wall, under direction of C. J. Lyons, scale 20,000 feet to the inch, or 1:240,000. It has been a handy map for general purposes for its small size. Mr. J. M. Donn of the U. S. Coast Survey, has lately been in the employ of the office, and has produced an elaborate contour map of Hawaii, scale 1:120,000, showing all ahupuaas, which has been printed in good style by Julius Bien of New York.

The accuracy of the triangulation work has been thoroughly tested. The circuit of Oahu by the series of triangles that made it, measures about 100 miles. The error of closure by Professor Alexander's work was about ten feet, or a tenth of a foot in a mile. A series of triangles mostly by a six-inch theodolite, was carried by Mr. Lyons from the Waimea base on Hawaii to Hilo, and a line of this triangulation extending across Hilo Bay, whose length was also derived from a measured line on the beach, was taken as a test line. The discrepancy of the two determinations was two-tenths of a foot in two miles. The average degree of accuracy of the triangulation may be placed as having an error of not more than 1 in 50,000. When we come to detail work there are two grades, the one the new work, which is intended as technically accurate, the other is of old work plotted in as best it can be from old notes of survey, and also of topographic detail, which is correct enough for general information, but is not minutely accurate.

The latest and most important change in the personnel of the Survey has been the resignation of Professor Alexander

to take a position in the U. S. Coast and Geodetic Survey. This took place in February, 1901, after thirty years of continuous and faithful service. Mr. Walter E. Wall took his place as Territorial Surveyor, which office, by the Organic Act, succeeded to the office of Surveyor-General.

CURTIS J. LYONS.

June 5, 1902.

APPENDIX NO. 4.—LAND MATTERS IN HAWAII, NO. 1.

BY CURTIS J. LYONS.

NOTE.

The following papers were written in 1874 in rather a colloquial style, and published in numbers in the "Islander," a Honolulu monthly of that year. As the use of the magnetic compass was quite general in those days, there being no surveyor's transits to speak of outside of the Government Survey, especial regard was had to that style of work in the chapters on surveying matters. Hence those chapters will seem quite antiquated to the present day surveyor. However it is hoped that they will be found always useful to those who have to retrace old magnetic lines, as the older lines always were, and that the whole series will be useful to those who, for the first time come to deal with our somewhat complicated system of land division and title.

Honolulu, July, 1902.

The change from barbarism to civilization that has taken place on these Islands has in no respect had more material importance than as regards land matters. A more generally diffused understanding of some subjects connected with these matters may tend to benefit the community, especially as it may enable some to comprehend and grapple with certain difficulties that are universally felt to exist, and which, however, seem to be beyond the combined skill and executive ability of any one individual to remove.

The particular kind of civilization that took root on Hawaii was not of the kind that destroyed all that preceded it. It might have crushed out all ancient vested rights, ignored ancient sub-divisions of land, and created a *carte blanche* upon which to begin *de novo* the marking out and mapping off of real estate; possibly endeavoring to introduce the monotonous rectangles of a United States public survey among the valleys and ridges of this diversified country.

Such a civilization would have treated the Hawaiian language as too paltry to put into print. Yet sometimes one is tempted to wish that not quite so much deference had been paid to the conservative side of the question. More of this hereafter.

The ancient divisions of land will therefore be our first subject to attend to. These Islands were, if the phrase may be allowed, tremendously peopled in many portions thereof. I can think of no word to express the swarming state of population that must have existed in localities. Even had Captain Cooke made no estimate, the evidences of such population are unmistakable. On general principles there must have been an inevitable diminution of the people with the advent of civilization, from the simple fact that the resources of the country would not support those same people as soon as their wants were increased. They were already industrious—what more could they raise from the soil, or furnish any way save as they pandered to vice, in return for the accoutrements of a new civilization. These are pertinent reasonings; certainly so to those who moralize on the diminution of races, though to follow them out would be a digression from our present subject.

Consequences of a long occupancy of the soil by a dense population—minute subdivision of land, and nomenclature thereof. Every piece of land had its name, as individual and characteristic as that of its cultivation.

The *unit* of land, so to speak, seems to have been the *Ahupuaa*. Its name is derived from the *Ahu* or *Altar* (literally, pile, *kuahu* being the specific term for altar) which was erected at the point where the boundary of the land was

intersected by the main road, *alaloa*, which circumferented each of the islands. Upon this altar at the annual progress of the *akua makahiki* (year-god) was deposited the tax paid by the land whose boundary it marked, and also an image of a hog, *puaa*, carved out of kukui wood and stained with red ochre. How long this was left on the altar I do not know, but from this came the name, ahupuaa, of the pile of stones, which title as given also to the division of land marked thereby. Many a time have I set up compass on ancient land marks of this sort, especially on Hawaii. One near Honolulu may still be seen on the north external slope of the crater of Salt Lake. This, besides marking the boundary of Halawa and Moanalua, marked also the limits of the Kona and Ewa Districts.

Near by I picked up an ancient ulu maika, the rolling stone of the bowling game of maika. The more common name of the altar on the Island of Oahu was *kaananiau*.

The Ahupuaa ran from the sea to the mountain, theoretically. That is to say the central idea of the Hawaiian division of land was emphatically central, or rather radial. Hawaiian life vibrated from uka, mountain, whence came wood, kapa, for clothing, *olona*, for fish-line, ti-leaf for wrapping paper, *ie* for ratan lashing, wild birds for food, to the *kai*; sea, whence came *ia*, fish, and all connected therewith. *Mauka* and *makai* are therefore fundamental ideas to the native of an island. Land as we shall see in a subsequent article was divided accordingly.

NO. 2.

In a previous article we have seen that the old Hawaiian system of dividing lands was preserved under the new system of titles; that in populous portions the subdivision was very minute, and that the main idea of the Ahupuaa, or primary division, was to run a strip from the shore to the summit of the mountain, in order to give an equitable share of all the different products of the soil and sea.

The Ahupuaa, however, was by no means any measure of area, as it varied in size from one hundred to one hundred.

thousand acres, and on the almost worthless wastes of interior Hawaii attained to an even greater extent than this. Taking the above mentioned island first in order, the common ahupuaa is found to be a strip say of 1,000 feet average width, and running from the sea shore, not by any means to the top of the mountain, but to the zone of timber land that generally exists between the 1,700 feet and 5,000 feet line of elevation. The ordinary ahupuaa extends from half a mile to a mile into this belt. Then there are the larger ahupuaas, which are wider in the open country than the others, and on entering the woods expand laterally, so as to cut off all the smaller ones, and extend toward the mountain till they emerge into the open interior country; not, however, to converge to the point at the tops of the respective mountains. Only a few reach these elevations, sweeping past the upper ends of all the others, and, by virtue of some privilege in bird-catching, or some analogous right, taking the whole mountain to themselves. Thus Mauna Loa is shared by three great lands, Kapapala and Kahuku from Kau, and Humuula from Hilo. Possibly Keauhou from Kona may yet be proved to have had a fourth share. The whole main body of Mauna Kea belongs to one land from Hamakua, viz.: Kaohe, to whose owners belonged the sole privilege of capturing the ua'u, a mountain-inhabiting but sea-fishing bird. High up on its eastern flank, however, stretched the already mentioned land of Humuula, whose upper limits coincide with those of the *mamane*, a valuable mountain acacia, and which, starting from the shore near Laupahoehoe, extended across the upper ends of all other Hilo lands to the crater of Mokuaweoweo.

These same lands generally had the more extended sea privileges. While the smaller ahupuaas had to content themselves with the immediate shore fishery extending out not further than a man could touch bottom with his toes, the larger ones swept around outside of these, taking to themselves the main fisheries much in the same way as that in which the forests were appropriated. Concerning the latter, it should here be remarked that it was by virtue of some valuable product of said forests that the extension of terri-

tory took place. For instance, out of a dozen lands, only one possessed the right to *kalai waa*, hew out canoes from the koa forest. Another land embraced the *wauke* and *olona* grounds, the former for *kapa* and the latter for fish-line.

On east Maui, the division in its general principles was much the same as on Hawaii, save that the radial system was better adhered to.

In fact there is pointed out, to this day, on the sharp spur projecting into the East side of Halealaka crater, a rock called the "Pohaku oki aina," land-dividing rock, to which the larger lands came as a center. How many lands actually came up to this is not yet known.

On West Maui the valleys were a very marked and natural mode of division. The question suggests itself as to how the isthmus would be appropriated. Some powerful chiefs of Wailuku and Waikapu seem not only to have taken the isthmus, but to have extended their domain well up the slope at the foot of Haleakala. So that there is the rare case of a long range of lands in Kula, East Maui, without any sea-coast.

On Molokai and Lanai, there are exceptional cases of lands extending directly across from sea to sea.

On Oahu the ahupuaa seems to have been oftentimes quite extended. Waikiki, for instance, stretches from the west side of Makiki valley away to the east side of Wailupe, or nearly to the east point of the island. Honouliuli covers some forty thousand acres on the east slope of the Waianae mountains. Generally speaking, however, the valley idea predominates. Thus Nuuanu (with its branch Pauoa), Kalihi, Moanalua, Halawa etc., are each the limits of single lands. So Waimanalo, Kailua, Kaneohe, Heeia etc., are ahupuaas. The long, narrow strip so common on Hawaii, is less frequent on this island, excepting in Ewa district. Singularly enough the ahupuaa of Waianae mounts the summit of the Kaala range and descends into the table land between Ewa and Waialua, and sweeps on up to the summit of the Koolau mountains. One would suppose that naturally that table land would be divided between Ewa and Waialua.

On Kauai, the writer is not familiar with the general divisions.* Probably the interior of the island belongs to a few large lands, while narrow and rather short strips are quite common along the shore, interspersed with large or first-class ahupuaas.

NO. 3.

The next subject that claims attention is that of the subdivision of the Ahupuaa.

The subdivisions of the Ahupuaa were called *Ili*. Some of the smallest ahupuaas were not subdivided at all, or at least seem not to have been; while the larger ones sometimes contained as many as thirty or forty ilis, each of course named with its own individual title, and carefully marked out as to boundary. The word is the same as that used to designate surface, and, in latter times, area.

There were two features of the ili, referred to by the terms *lele* and *ku* which are worthy of notice. The former is its desultory character, like unto that of the States of Germany. That is to say, the ili often consisted of several distinct sections of land, one, for instance, on the seashore, another on dry, open land or *kula*, another in the regularly terraced and water kalo patch or *aina loi* district, and another still in the forest, thus again carrying out the equitable division system which we have seen in the ahupuaas. These separate pieces were called *lele*, i. e., "jumps," and were most common on Oahu. Indeed I know of none on the Island of Hawaii. Some remarkable examples occur near this town. Punahou had anciently a lot on the beach near the Kakaako Salt Works; then the large lot with the spring and kalo patches where the school now is, and again a forest patch on the steep sides of Manoa Valley. Kewalo meanwhile had its sea-coast adjoining Waikiki, its continuous *kula* on the plain and one half of Punchbowl hill, and its kalo land in Pauoa Valley. Kaa-kaukukui held Fisherman's Point, and the present harbor of Honolulu, then kalo land near the present Kukui Street, and also a large tract of forest at the head of Pauoa Valley. The kalo lands of Wailupe are in Palolo Valley. In Kalihi and

* Maps have since been made which show the conditions.

also in Ewa are ilis with from eight to ten different *leles*, a most prolific kind of lands, and now furnishing a truly desultory job for a surveyor to map out.

These different pieces are called variously, either by their own individual name, or by that of the whole ili, thus puzzling one sadly when attempting to obtain information with respect to them.

The Second feature is referred to in the word *ku*,—short for *ili kupono*. There were two kinds of ili; the ili of the ahupuaa and the ili kupono. The ili of the ahupuaa was a subdivision for the convenience of the chief holding the ahupuaa; *alii ai ahupuaa*.

The *konohikis* of these divisions were only the agents of the said chief, all the revenues of the land included, going to him, and the said land, in Hawaiian parlance, “belonging to the ahupuaa.”

The *ili kupono*, on the contrary, was nearly independent. The transfer of the ahupuaa to a new chief did not carry with it the transfer of the *ili kupono* contained within its limits. The chiefs previously holding the ili kupono continued to hold them, whatever the change in the ahupuaa chief, having their own *koeles* (chief's patches) worked by their retainers. There was, however, a slight tribute of work due to the ahupuaa chief; sometimes one or two days in the month; sometimes even less, or only certain days in the year. The ilis which were used as places of refuge and those of the god Kaili, did not render even this tribute. Such were Kaahumanu's ilis in Waikiki.

Of the ili kupono, Waimea, on Hawaii, furnishes an eminent example. Nine-tenths of this ahupuaa are taken up with the independent ilis of Puukapu and Waikoloa, to say nothing of half a dozen small ones of the same kind. Accordingly when Waimea Ahupuaa was declared in late years a Crown Land, it was necessary to declare Puukapu also a Crown Land, as though not included in Waimea. Waikoloa was given by Kamehameha I. to Isaac Davis, and it has remained in the Davis family ever since.

When, therefore, the limits of Waimea were settled by the Boundary Commissioner, the Crown Commissioners knew hardly more than they had previously, of where the Crown Land was situated. How much labor and confusion this principle has brought about remains to be seen.

Within the ilis all large kalo patches seem to have specific names, especially on Oahu, which was the most microcosmic of the islands. The *koetes*, or chief's patches, more particularly. *Kihapai's*, i. e., dry land patches, with their intervening ridges of small stones, or earth or weeds, had also their appellation. These ridges of cultivation, often rows of sugar cane, too, were in cultivated sections very frequently the boundaries of the ahupuaa, called *iwi*, (bone,—short for *iwi kuamoo*, backbone), and curving enough they are. Sometimes changed in ancient times, amidst fierce battling between the clans each chief could summon from his land.

The date of this division is fixed about twenty generations back in Hawaiian tradition, the names of the chiefs establishing it being given. The Moku or District was fixed at the same time, such as Kona, Kau, Puna, Hilo, Hamakua and Kohala on Hawaii. On Maui are some smaller divisions than the Moku, called *kalana*, Lahaina being one of these. Wailuku, Waikapu, Waiehu, and Waihee were independent, belonging to no Moku. On the map it was necessary to form a new district and call it Wailuku, Nawaieha, the four waters, being too cumbersome and ill understood. Olaa, on Hawaii, is said to have been independent of Puna, and Waimea of Kohala. Otherwise the district division was very exact and comprehensive.

One other anomaly remains to be noted here. A large tract of forest land in Hamakua, Hawaii, was once cut off from a number of ahupuaas for the use of the whole district, and is called Kamoku to this day, becoming at the time of the "mabele" which must come next in our way,—Government Land.

NO. 4.

We now come in regular course to a brief notice of the Mabele.

The Mahele was a phenomenon in natural history not often repeated. The Mahele was, in one sense, a revolution. In another sense it was eminently a conservative movement.

To write a full history of this change would require more leisure, or more correctly speaking, more time and strength than most persons in our community and in active life have at their own command. It will only be in place here to indicate its main features. I am very well aware that there will be widely different views on this subject among those of the legal profession, and those put forth here may be called decidedly unprofessional. It may be suggested, however, that occasionally the unprofessional opinion has the advantage. This is often the case with respect to theological matters, sometimes decidedly so in medical matters, and the common sense of honest jurymen frequently cuts at once through the entanglements of legal questions on both sides to the desired point of equity and justice to both sides.

The *Mahele* was simply an endeavor on the part of the majority of the Hawaiian chiefs, and especially on the part of Kamehameha III. to secure to all parties what, on the ordinary principles of acquiring property, seemed to belong to them. It was contemporary with the organization of the departments of the Hawaiian Government in 1845-6.

The theory which was adopted, in effect, was this: That the King, the chiefs and the common people held each undivided shares, so to say, in the whole landed estate. Whatever the legal deduction from the status under the former feudal system might be, the fact in equity was acknowledged, that whoever had a share in making the land valuable, held an interest in that land.

Legally speaking, the title of the whole was in the King. The King, who conquered the whole, viz.: Kamehameha I., had partitioned the lands among his warrior chiefs, retaining a certain revenue from them, in default of payment of which, the land was forfeited. These chiefs did the same to those below them.

Kamehameha III. for the common good waived his title to the whole, under conditions. Conditions, that those under

the chiefs should be treated in like manner, and moreover, that a certain portion, one-third, should be given to a common landed estate called Government Lands, the proceeds of which were to go to the public treasury, and which should furnish that facility for the acquirement of real estate in fee simple, which is so necessary for the growth of a community.

In other words, the Hawaiian nation agreed to divide as individuals their as yet undivided inheritance, the King taking a share proportioned to the general idea of the dignity of his position. (It should be stated that the word *Mahele* signifies division.) It was moreover agreed that there was to be a portion devoted to the general good in two ways, viz.: by rendering it obtainable to those who desired land, and by using the proceeds for the benefit of the public treasury. It will be seen that there was a double mahele,—first of all, among themselves, and second, of each with the general treasury. This last was the trying point with the chiefs; it required no little effort to bring about its accomplishment, and no little self-denial and resolution on the part of those who thus gave up what they regarded as their lands. The scenes in the meeting of the council for this purpose have been described by eyewitnesses as thrillingly interesting. Almost every one of those who took part in this peaceful, but patriotic revolution, has gone from the presence, we hope not from the remembrance of this community. Among the ranks of these noble dead, are Kamehameha III., and Ke-kuananoa, Pahi, Kekauonohi, John Ii, who was most active in bringing about the change, and a host of lesser chiefs. Messrs. Richards, Judd, Ricord and afterwards Lee, were the leading spirits in inducing the chiefs to see the benefits of the new policy and system.

There were two great sacrifices made by the chiefs. The division with the Government we have noticed. Far be it from any one to misappropriate these Government lands, thus conscientiously given up by the old Hawaiian chiefs for the national good. The other sacrifice was that of the *Kule-ana*, or land of the small tenant. These small tenants were permitted to acquire a full title to the lands which they had

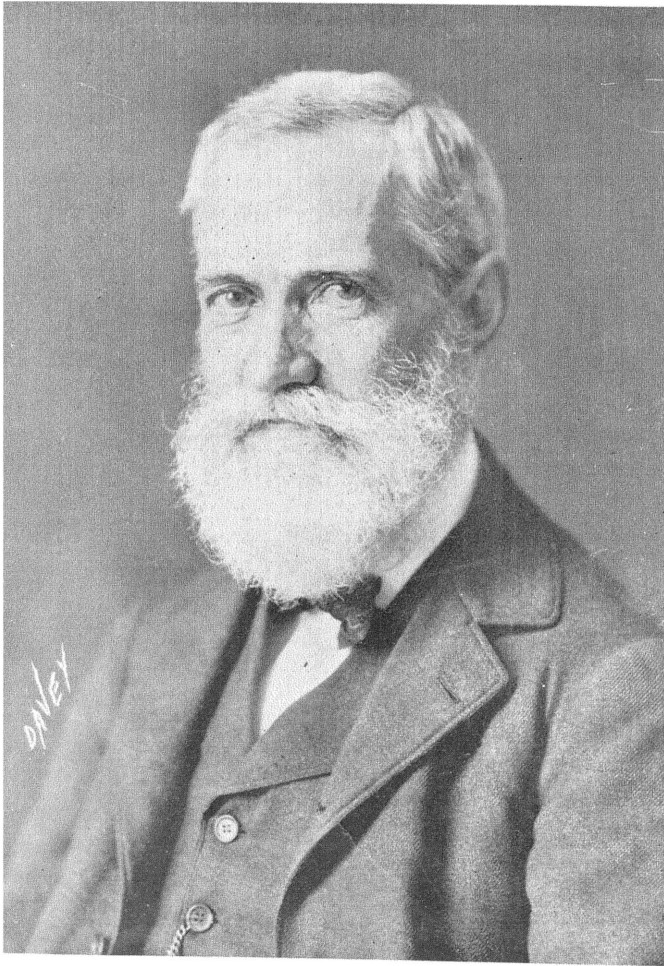
been improving for their own use. In the true view of the case, this was perfectly a measure of justice, for it was the labor of these people and of their ancestors that had made the land what it was. This subject will lead us to consider the Land Commission.

NO. 5.

The lands having been divided as we have seen in the last article, it became necessary in order to establish the real estate business of the Kingdom on a practical basis, to give some formal evidence of title sanctioned by the Law of the land. The mahale was an anomaly. The Land Commission appointed to carry out the principles of the mahele, was another. Both were eminently practical and just in their idea.

Five gentlemen, John Ricord, William Richards, Z. Kaauwai, James Young Kanehoa and John Ii were appointed by the King in February, 1846, to hear testimony upon the claims of individuals, and to issue awards to the claimants for the land claimed, by metes and bounds. These Commissioners drew up a careful statement of principles to guide their conduct in making the awards.

This statement was approved by Act of Legislature and made law. It was further ordained that no claim should be valid unless approved by them, and unless presented before a certain time. The only appeal was to the Supreme Court. The Commissioners took the oath of office, and held their first meeting for regular business in March, 1846. The first claim and award signed was to James Voss, on the lot at the South corner of Hotel and Alakea Streets. The taking of testimony was a herculean task when we consider that the number of claimants were over ten thousand. It was found that the taking of testimony, the surveying of boundaries, and the making final award, would each have to be separate stages of work. Accordingly, while the first volume of Land Commission Records contain lengthy masses of testimony attached to each award, in the second volume awards only are given; the testimony being thereafter by itself in another series of separate vol-



CURTIS J. LYONS.

umes. The Commissioners worked with most commendable energy, going to every part of the islands to meet the people, and prepare for awarding the kuleanas.

Kuleana means originally a property or business interest in anything. The common people were in former times assigned certain portions of the chief's lands, to occupy at the will of the chief. Generally speaking there was a good degree of permanence in this occupancy, provided that service was duly paid to the superior. In 1839 a law was promulgated that no one should be deprived of this land without due cause, which law was a preliminary step to the subsequent one of giving to all these common people who would come forward, present their claim, their testimony, and pay the expenses of settling the whole matter, a fee simple title in their improved lands. In the town of Honolulu all lots were to be subject to a commutation fee of one-fourth of their unimproved value to the Government. Elsewhere the award was in fee simple without commutation. These awarded claims came to be known by the term "kuleana."

After the testimony in regard to their existence was taken, the next step was to scatter a horde of surveyors all over the Kingdom, with memoranda of claims, to survey each separate one by itself, and send in the survey to the office, generally on a sheet of foolscap paper. At the office they were copied in huge unwieldy volumes. Volumes, however, ten in number, of infinite value to the real estate interests of this little Kingdom. Of the surveys more hereafter. They were generally paid for by the piece, at the cheap rate of two to three dollars per kuleana. The total expenses, for the Land Commission expenses were all borne by the claimants, and amounted to from \$6.00 to \$12.00 to each kuleana. Cheap enough; yet the poor natives were often a long time in collecting the amount to pay over to the agent who distributed the papers containing the awards.

In fact it seemed all like a dream to the common people, so long serfs under masters. All sorts of reports would spread through the country, to the effect that the whole thing

would be knocked in the head; that such and such lands were to have no kuleanas taken out of them, &c., &c.

Then there was a vast deal of haphazard about the matter. In kalo patch land it was comparatively easy to determine where and where not the kuleana should extend, though many a contest between the claimant and konohiki chief's man took place even there. It was impossible for the Commissioners to go upon the ground, so that responsibility in a large measure depended on the surveyor. In dry or kula land, where the soil has to remain fallow for years between crops, it was difficult to decide what a kuleana should contain, and as we shall see there was much variety of practice.

NO. 6.

Mention was made in the last number of the haphazard or lack of uniform rule in establishing the boundaries and extent of kuleanas. The best illustration of this may be derived from an example. Three surveyors were sent to Hawaii to as many different districts to measure and report kuleanas. Directions, "to include what the claimant has cultivated and improved." Surveyor No. 1, a stranger to the country, found the people cultivating on the kula land say two or three acres of upland kalo. Not taking into account the fact, alluded to in our last number, that it was necessary for the land to lie fallow for two or three years before another crop of kalo could be produced from it, he surveyed merely the amount under actual cultivation. The kuleanas were awarded accordingly, the poor people having no one to take their part, and, as a consequence, in many cases abandoning their newly acquired property as utterly insufficient for their needs.

No. 2, a native Hawaiian, was assigned to a district where the resident American missionary was one who took an active interest in the new order of things, and who believed, and not without some reason, that the people had the main right to the land any way, on general principles. The consequences of this was that the surveys were sent in from fifteen to thirty and even forty acres in extent and were awarded.

Surveyor No. 3*, meanwhile, after an arduous campaign, among the kalo patches, with an ever watchful konohiki to contest his progress, and to whom the reply to appeals for advice to the Land Commissioners was sent, "Do the best you can," came out into the kula lands of his district. Multiplying the amount under actual cultivation by the number of seasons in which it would have to lie fallow, the estimate was made of from six to twelve acres as the ordinary run of upland kuleanas, and surveys were sent in accordingly. Reports of what was going on in the neighboring districts soon came in, and, rather puzzled thereby, our man lay on his oars a few weeks to see what would turn up. Finding that his surveys, too, were approved of, he went on through the district on his own principles.

In the defense of the above inconsistency, the plea may be urged, that the Commissioners had such a mountain of business to dispose of that "Any way to get through" might well be their motto. To re-survey in all these cases was next to impossible, also to obtain full information. Then, while there lived a king who thus favored his subjects it was expedient to make all speed possible, lest a change might introduce worse confusion.

Another inconsistency was in the awarding of titles below high-water mark, and on reefs in some instances and not in others. The immediate vicinity of Honolulu harbor as compared with Pearl River and Kaneohe Bay furnishes a notable instance of this.

After the awards of the kuleanas came the awards to the lesser chiefs and to foreigners to whom lands had been given of the ilis we have described above. They were generally though not uniformly awarded by their external boundaries, expressly stating in the award, and in the patent based thereupon the *excepting of all kuleanas contained* therein.

The ahupuaas were awarded to the chiefs to whom they belonged in a similar manner, the exception including the ilis

* The writer.

awarded as above, and also such ilis as by the Statute law were declared on the basis of the Mahele, as we have previously seen, to be either Crown or Government Lands. Of course when the Mahele was made the division took place; the ahupuaa to one chief or to the Crown or Government as the case might be, and the ili kupo, described in a previous number to other chiefs or the Crown or Government as the case might be. The Crown and Government lands were expressly set forth by name in the Statute, at the same time that the Land Commission was created.

It is this *existence of titles within titles unseparated one from another by especial survey* that creates the unmitigated state of confusion that now exists on these islands. It might as well be confessed and made public, that adequate steps may be taken if possible to clear up the confusion, heightened as it is ten-fold by the fact that all the kuleanas are recorded each by its own individual configuration and extent with no general map of the district. In the prospectus, so to call it, of the Land Commission, it was declared necessary to know the "configuration and extent of the several claims." The very important item of *location* was omitted. It was probably impossible to have carried out any general system of measurement which would have secured this, when we take into account the imperfect instruments employed by most of the men who were employed in this really national work.

Another example from actual experience may come in here, perhaps to advantage. In Kalihi, Oahu, is an ili of Government land. A large part of it was taken up, as usual, with kuleanas of the people resident thereon. The remainder was in all conceivable shapes, mixed in the interstices of the kuleanas, including, however, some very valuable land. For some years the sovereigns of the country diverted this land to their own use. When afterwards it was deemed advisable to use or dispose of the land for the benefit of the Government a survey was necessary to find where the Government land was situated. To this end, every single kuleana lot to the number of fifty or thereabouts had to be re-surveyed and located, errors, inaccuracies and magnetic variation all to be taken into

account and their descriptions made out of what remained, to agree with the adjoining kuleanas, the whole involving about two months of labor. The resultant remainder of Government lots of land were worth somewhere near \$1,500. More of this hereafter.

NO. 7.

To sit in judgment on the past is not always advisable. It is easy, in the light of subsequent events to perceive what would have been the wiser course. But it is not always easy to put ourselves in the places of our predecessors; to realize what difficulties may have beset them, and what obstacles may have prevented the carrying out of their own conceptions of what should have been done.

This remark applies to the work of the Land Commission. The following imperfections in their work are very noticeable:

First—That already noticed, including titles within titles; kuleanas within ilis; ilis within ahupuaas and so on; without distinct specification of what was excepted within. It has frequently occurred that persons have purchased estate on the basis of the acreage of the whole, and then found, to their dismay, that one-fourth, or even one-half of the area specified was taken up in kuleanas; titles in fact just as good as that of the larger estate around them. This has been a standing grievance with purchasers in this Kingdom, and has tended to bring the kuleana system into disfavor.

Second—The Land Commission ought to have continued till all the land had been properly apportioned and award passed thereupon by the Commissioners, including in these awards also the Government and Crown lands. The object aimed at, viz., the settling, for once at least of titles, would then have been gained. The omission of the Government and Crown Lands has created uncertainty all over the group as to boundaries even to this day. The almost unlimited powers of the Commissioners should have been used to put matters in a practical and accessible shape.

Third—The number of steps requisite to procure a full title has been too great. First the mahele, then the award, then

the Royal Patent. Now in the town of Honolulu, we will say, A and B have adjacent lots.

A procures his award, and immediately goes on, pays the Government commutation, and receives a Royal Patent. B merely contents himself with the Land Commissioners award, leaving the future to look out for the payment of commutation. A and B both sell to C. C cuts up his property into small lots and sells. Now in some or other of these lots there will be at the same time land commuted for, and land as yet uncommuted for. D, who has purchased one of these heterogeneous titles, wishes a full title, and is obliged to hire surveyors, lawyers and what not to find the imaginary line in his property, dividing the patented portion from the unpatented; describe the unpatented portion, and take out his "R. P." for the same in the name of the original awardee, dead, say twenty years ago. It would seem as if this threat of a Government one-fourth ought to have been disposed of at the start.

Fourth—While the surveys were carefully recorded and indexed, there was an unaccountable lack of uniformity in the methods followed in making them. It would seem as though a person having the practical knowledge possessed by the late Hon. W. L. Lee, for so many years President of the Commission, would have issued certain uniform rules to the persons employed. Instead thereof, we have every possible method of measurement adopted, every conceivable scale employed, meridians pointing everywhere, no marking of corners; in short, everything left to the sweet will of the man who was hired at from two to three dollars per kuleana to do the measurement. Nor was one district assigned to one man. No less than a dozen tried their hands at Waikiki, no one being required to guide himself by the notes of another. Of course overlaps and interlayers are the most common things imaginable. It has been the practice heretofore to regard the person holding the earlier award to take precedence in the case of an overlap, and the one holding possession in the case of an interlayer. Some doubts in high quarters have been expressed however on this matter.

As we have said above, the real reason for all this looseness lies in the fact that there was little money to pay out, and little time to wait, for the work. It may be added that there was not then a single thoroughly competent land surveyor on the ground. The grounds for this assertion may be stated hereafter. Civil engineers there were and amateur surveyors, but no thoroughly competent land surveyor.

To hasten the "quieting of titles" it was enacted by the Legislature that all claims not presented before a certain date should revert to the Government. This date was postponed several times. The Land Commission itself was driven to the policy of awarding titles by ancient boundaries without survey; that is to say, simply by the name of the ahupuaa or ili, leaving the owners to fix the boundaries as best they could. In that way it was enabled to close its labors at the time prescribed by the Statute, viz., on the 31st of March, 1855. The receiving of evidence was finally closed on the 30th of December previous.

Even then an act had to be passed in 1862, "for the relief of certain Konohikis," enabling some such who had received land at the time of the mahele to receive an award from the Interior Department for the same, up to a certain date, beyond which, the land if unawarded was to revert to the Government.

The question now comes up: Will these lands thus unawarded now be claimed by the Government? and, moreover, will similar lots in town be thus claimed?* The view of the case taken at the time, was this: "For the good of the community, land owners must be compelled to go through certain forms of law, failing in which, the lands are forfeited. "Was or was not this in the circumstances a constitutional act?"

NO. 8.

The land in the Hawaiian Islands was considered at the time of the Mahele as belonging to the nation. It was divided

* The point has since been settled. *Ed.*

off according to principles deemed equitable, and titles were given emanating really from the Government representing the nation, by the King as the executive power. This I think is the true theory of the then new departure in land matters. The power to whom were given the Crown Lands was not the power that gave legality to the new titles. The Crown Lands were set aside for the private emolument of the King. The Government Lands were for the benefit of the whole,—for the parties as a whole, that divided the land.

When, therefore, the rule was made, or law passed, that lands not awarded should vest in the Government, it would have seemed to be perfectly in the power of those making the law, so to enact. It hardly seems proper, therefore, at the present day, to assume that such lands should revert to the Crown as “Crown Lands.” They should revert to the Crown as the representative of the Government, not for the private use of the King, but for that which the King represents in his official capacity.

Where parties have been for a long time in actual occupation of such lands, it would seem as if some liberal terms might be adopted which would facilitate the obtaining of a title without waiving the right of the Government, against which the statute of limitations, *i. e.*, of twenty years occupation, does not hold.

LAND SALES.

The Government Lands about the year 1850, were put into the market throughout the islands. Previous sales had been made in a few localities, especially in Makawao and Manoa Valley. Agents were appointed in the different districts to receive applications, to attend to the surveys and to report, also to collect the money for the land and forward to the Interior Office. The same desultory system of surveying was followed as in the case of kuleanas. Probably between the year 1850 and 1860, nine-tenths of the available Government Land was taken up.* The agents were some of them the Am-

i. e. what was then regarded as available.

erican missionaries, who considered it not inconsistent with their position to assist the people in obtaining lands, in advance of mere speculators. A commission was allowed; in at least one case it was declined, all service being rendered gratis.

After all this selling of land, the Government was perfectly in the dark as to what remained. A lull in the business took place, and when in after years some of the remnants were applied for, it was impossible to proceed with any confidence in disposing of them. In addition to this, a new policy came in with another administration, of refusing to sell land. Partly, from the revival of the ancient theory that the King was the Government; partly from a feeling that a fixed revenue might be derived from the remainder; partly from the cropping out of the over-prevalent dislike of seeing lands go into the hands of foreigners; and partly from the difficulty of proceeding intelligently to work.

For instance; and this is from actual experience; a tract of, say ten acres, in Palolo Valley remained to the Government. It lies at the foot of the steep valley side, and may or may not extend up that side or pali to its summit. The land above was awarded by survey, and to find how far down the face of the mountain it may extend, it is necessary to run all the old lines of that upper land—probably two or three days of hard work would be none too much to do this in a reliable manner. In fact, one can be sure of nothing in such cases without surveying all the adjoining lands. A perfect incubus this has been on the disposal of the remaining Government Lands.

It was this state of things, as much as anything else that led the late Minister of the Interior, Dr. F. W. Hutchinson, to institute the Government Survey. A general survey seemed the only possible way to get at the facts of the case. It would be perfectly impossible for the Government to-day to state definitely what land it possessed in any one district.

Add to this the need of general maps for business purposes, for assessment of taxes, for any discussion of schemes for the benefit of the country; for searching of records; for the information of courts of law; of strangers, especially of scientific

men; to say nothing of navigators; and one sees abundant reason why a general survey should be made.

Moreover, the Government failed in one important part of its duty; namely in locating its own grants and awards. It is but fair that it should undertake that work as far as it is practically useful and is possible without too great expense.

Another demand for general maps lies in the fact that while a person may in a few years become a walking encyclopedia of information respecting localities and titles, &c., in a district, he is liable to leave at any time, when all his stores of knowledge become annihilated in a moment, no record thereof being left for the benefit of his successor.

NO. 9.

There is now remaining to be noticed the "Boundary Commission" business. As was stated before, a large number of Ahupuaas and Ilis were awarded by name only. The Land Commission having ceased to exist, it became necessary to provide some means of legalizing the lines of boundary between awarded lands wherever they had not been awarded by survey. This and nothing else is the business of the Boundary Commission. It is not concerned with boundary disputes as such. It is only when the locality of an award, and in a very few cases of a Royal Patent, has nothing but the ancient traditions and testimony founded thereon to determine it, that the Commissioner is called upon by the owner to issue a "Certificate" defining it "either by survey, or by natural topographical features, or by permanent boundary marks." It will be seen that a description by means of ancient names of localities,—"*wahi pana*"—is not in the limits of the statute.

The act for the appointment of Boundary Commissioners was passed in 1862. At first there were two for each gubernatorial district, the Police or District Justice in each place acting as umpire in case they disagreed. This, as might be expected, was a failure, and subsequently the late G. M. Robertson of the Supreme Bench became sole Commissioner for the group. In 1868 the law was modified, since which time there have been four Commissioners, one in each main dis-

trict. Their work has progressed very slowly owing to various causes.

It is a matter of regret that there has been so little uniformity in their methods of procedure. Of a large number of lands thus defined, no maps whatever have been filed in the Interior Department. Complaints often arise that sufficient notice is not given to parties concerned, residing as they oftentimes do at a distance. The best way of procedure would seem to be this: Maps of the lands in question prepared from good surveys by persons approved at the Interior Office, and containing such full information as to be intelligible to all concerned, should be on file in some public office, say for ninety days previous to the decision, and due notice thereof should be given in order that all parties may consider the matter at their leisure.

A better organized Land Office is very much needed. The General Clerk of the Interior Office has too great a diversity of business to give due attention to it. The second clerk is occupied mainly in making out Royal Patents on awards and furnishing copies of documents. The Surveyor-General has the Topographical Survey on his hands, while his assistants are bandied about from one job to another, the whole groaning under the weight of the tanglement of old and new that has been previously pointed out in these papers.

The object aimed at should be that the Government should know the location of its own Patents for Land, and to be able to furnish information concerning the same. It should know too, what is left unpatented, and it was more for this object than any other that the then Minister of Interior, F. W. Hutchinson, instituted the Government Survey in 1870.

The remaining stage in the history of land matters in these Islands is the work of the Boundary Commissioners. Before noticing this subject, it may be well to introduce a few articles on practical work relating to boundaries. It results from the nature of the case, that a large part of the surveying of boundaries must be done by amateurs, especially of small lots in the country districts. That is to say, by persons who, having had a general education, take up the business for

a year or two, or who, engaged in other pursuits, yet keep on hand a compass and chain for necessary occasions. It could be wished that it were otherwise, but it is probably best to accept the situation and make the best of it. Perhaps good service can be rendered to land owners by furnishing a few hints on subjects not treated in books on Mensuration. These books are generally prepared either by professors in colleges, who have little idea of the real nature of work in wild countries, or of the real work anywhere, or by those at the head of large operations in topographical work who have not had experience in small boundary matters.

There are two very distinct divisions of a surveyor's work, viz., describing or making new surveys, and locating or running out the old ones. The popular idea is a correct one, that a piece of land should be so described that its corners can be located with certainty, even a hundred years hence from that description, and without the need of consulting half a dozen others of the same sort. Of course only such surveys are competent ones. We will see how matters stand here. The great bug-bear of boundary running in this country is the magnetic needle with its liability to disturbing influences. With *distances* there is no especial difficulty, save carelessness. With *directions*, however, the case is very different. Were the rhetorical figure, "true as the needle to the pole" a correct one, it would be a very simple matter to set up a compass on a station, and from a direction of the magnetic needle sufficiently delicate to indicate a movement of five minutes of arc, as the better American instruments will do, find the direction of a line. Such, in fact, is the theory of the books for the most part. The figure, however, is not correct; the magnet revolves around the true pole, instead of remaining stationary, and the needle—and this altogether the worst feature of the case—turns toward iron ore wherever it exists, and is therefore altogether a very unsatisfactory standard of direction—in fact no standard at all.

It does not follow from this that the compass cannot or should not be used for measuring or locating lines. It is quite the fashion at present to blame everything on "the im-

perfect instruments of former days." It is the imperfect surveyor that is to blame. Very good work, work perfect enough, or, to speak more accurately, near enough to perfection for practical purposes, and for all questions that ought to arise, *can be done* with the common compass. Provided, however, that the person using it knows how to adjust every part of it, and provided also that he knows what to do with the so-called "variations" of the needle.

In point of fact, the only instruments indispensable to a competent surveyor, for which also he needs the assistance of the machinist, are a tripod with a ball-and-socket joint, and a pair of dividers. Some of the greatest results, in every branch of knowledge, have been obtained with the simplest means. Put on the above mentioned tripod a plain board, easily levelled by means of the ball-and-socket joint; on this, a 12-inch graduated circle of paper, laid out by means of the dividers, which we have provided; a wooden rule with a pair of wooden sights, one of which can be mounted with a horse-hair; and a sewing needle to indicate the center of the circle, and with a proper use of the pole star or of the rising or setting sun for a true meridian—with this simple outfit, work could be done more accurately than nine-tenths of what is recorded in the Land Commission Records.

But to return to the compass. It has the advantage of being portable, is not a source of constant anxiety, and can be used, as a theodolite cannot, all day in a pouring rain.

To elucidate the matter of local magnetic deviation, and the endless confusion resulting therefrom, an example may be brought forward; using for this purpose not only a supposable, but a very probable case. Take a rectangular lot, 344 feet square; this size is taken because a difference of one degree of direction, in a side of that length, will make a difference of six feet in locating the corner at the end of that side; ten minutes of arc, one foot; five minutes, six inches; this last being at the same time the least amount about which any question ought to arise, and the least observable with the compass. We will now suppose the bearings of the successive sides, by a true meridian, i. e., one pointing to the

true north pole, as follows, beginning at the south corner: 1 at side, N. 70° E.; 2nd N. 20° W.; 3rd, S. 70° W.; 4th, S. 20° E.

Now take a very common case with reference to this lot; suppose at the initial or South corner of the declination of the needle, i. e., its deviation from true north is 10° E; at the next or East corner it is 9°; at the North corner it is 8°; at the West corner it is again 9°; this last being the normal declination for the district where the lot is situated. A mass of rock or of black sand under the surface would easily produce this irregularity.

What in such a case will be the standard of direction? There have been three different methods followed by the persons employed at these Islands. The first class may be called the local needle surveyors. They use the needle for a meridian just as it stands at each station. In this case there would be three different standards of direction employed. Of this more hereafter. The second class are the initial needle surveyors, who use the meridian as indicated by the needle at the initial point of the lot as the standard for the whole. The third class may be said to use the average needle method. The magnetic meridian as indicated at the 9° stations would be the standard in this method. I will now give the notes of surveyors of this lot by the three different methods, as well as the true notes:

No.	True mer.	Local needle.	Initial needle.	Avg. needle.	Distance.
1—	N 70° E	N 60° E	N 60° E	N 61° E	344 feet
2—	N 20° W	N 29° W	N 30° W	N 29° W	344 feet
3—	S 70° W	S 62° W	S 60° W	S 61° W	344 feet
4—	S 20° E	S 29° E	S 30° E	S 29° E	344 feet

The middle three columns give a bona fide specimen of what is really the fact with respect to magnetic surveys. The reader may study out the matter and meditate on the probable confusion likely to arise until the appearance of the next article, if the latter is not too long delayed.

NO. 10.

The magnetic needle having been used as the basis for the describing of boundaries in this country, it becomes thereby an object of study, in order that persons locating those boundaries may proceed with any degree of certainty. As the writer has been requested to make especial investigations in this matter, in connection with the work of the Government Survey, and as the collection of information on this subject is strictly within the scope of that work, this occasion is taken of presenting some of the results of such investigation.

Three different elements of uncertainty must be taken into consideration in following the magnetic bearings given in old records, that is to say there are three different questions to be considered. First: has the direction of the needle changed, say in the last twenty-five years; if it has, how much and which way?

Second: What local causes affect the needle, and in what manner and degree do they affect it?

Third: What method was followed in the original survey, the "local needle" method, "initial needle," or "average needle" method? And did the instruments really indicate the magnetic bearing, or was there in many cases an index error?

It will now be seen that the old proverb, "Lazy folks take the most pains," is not without its application here; that it involves as much work to depend on the needle as to ascertain and use a true meridian, and infinitely more vexation. Our paper, too, threatens to become scientific, concerning which fact it may be said, that a little study will hurt no one, and benefit many.

As to whether the needle has changed its direction, there are different opinions.* One, that there has been no change in the period above mentioned; seeing that so many known

* This question has been settled since this was written.

lines appear to have the same bearings as when recorded about 1850. Moreover, there are records of old observations of magnetic declination, differing but little, if any, from the present.

The British Admiralty Chart, while expressing uncertainty on the matter, says that there appears to have been a slight motion of the needle to the Westward. The opinion of others is that the needle has moved to the Eastward, at the rate of about $1\frac{1}{2}$ minutes of arc per year. That is to say, the Easterly Declination forty years ago was $8^{\circ} 15'$, and at present is $9^{\circ} 15'$ for the Island of Oahu. This is my own opinion, and the reasons for it will be given.

Records of magnetic declination, as observed by old navigators, are sufficiently correct for sea-going purposes, but not for the present purpose. If made at sea the observations are not over accurate; if on shore, a great number of stations must be taken to be sure no local influences are at work. On Quarantine Island, west of Honolulu Harbor, the declination in 1871 was $9^{\circ} 35'$, while on Fisherman's Point (Kaakaako), east of the same harbor, it was $9^{\circ} 18'$, and this uniformly over a large area of either locality. At Kealakekua Bay and Kawaihae, the needle would doubtless be drawn toward the mass of land to the eastward.

Then as to the bearing of old lines. In the first place one can never be sure from which end of the line the bearing was taken. The writer has often been nonplussed in this respect. In the second place the old compasses did not agree among themselves, varying nearly a whole degree. And it is very hard to find old lines of perfectly undoubted authority. The only really reliable evidence is from observations, taken from the same point, with the same compass, of a large number of prominent points, with an intervening period of quite a number of years. If the result of this is corroborated by other evidence, it may be relied upon.

In 1853 I took, with great care, the bearings of a number of well defined mountain summits from a known locality on Hawaii, where no change in the needle would be caused by moving from 40 to 50 feet in any direction. In 1872 the

same bearings were observed with the same instrument, which at both times was in good order. The difference was about 40', as specified above, plus on Northwesterly bearings, and minus on Northeasterly. A good many other observations corroborate this definite result, and the testimony of the late S. C. Wiltse, who had an opportunity of running a large number of long lines on North Hawaii, where good boundary marks existed, was decidedly to the same effect, viz: that the needle pointed 40' to the eastward of what it did thirty years since.

Wilkes' Exploring expedition visited these Islands in 1841. The "variation" marked on their charts is $8^{\circ} 15'$. Now this expedition was not always correct in its reports, but it would hardly seem probable, that with all the facilities at their command, that they should be far out in this point. Their observatory I believe, was in the Palace grounds, the present declination being $9^{\circ} 15'$ in that neighborhood. This would corroborate the above result.

It is desirable that those who have the facts bearing on this subject, should communicate them.

"Well, what of it?" some one says. Simply this, that it makes a difference of direction of one foot for a hundred feet distance, or twenty-five feet in half a mile. Now supposing a lot, one-half mile square, bordering on the sea shore say a sand beach, with no permanent marks thereupon, the inland corners are fixed and known. For the location of the points on the beach, there is no guide excepting the magnetic bearings from the known points. A difference of twenty-five feet, produced by ignoring the change in the needle (called the secular change), would give room enough one side or the other for a small cottage. If such a building happened to be, as it well might be, on the disputed ground, a good line of litigation would probably ensue. That is where the practical side of the question would appear. Cases just like the above do occur. It does not follow, however, that the allowance for variation should always be made, as there are other things to be considered.

Local magnetic declination is the term that should be applied to the angle which the needle makes with the true meridian at any particular station or corner. *Local deviation* may be used to express the amount of *difference* between this and the *normal* declination, or that which would exist if no strictly local causes affected the direction of the needle, and which as we have seen, is about $9^{\circ} 15'$ at present on Oahu.* Having disposed of the "secular change" we now come to this subject of local deviation, as manifest in the varying amounts of the declination at different localities.

The directions for work, in the books on compass surveying, proceed on the theory that the needle, in any section of country, has a uniform declination, especial stations alone excepted, and that only these special stations need attention. But on these islands the especial cases are the majority. That is to say, on average ground, not more than one-half of the stations will be found to agree among themselves, the others indicating a local deviation of from 15 minutes to two degrees in either direction from the normal declination.

At present, on work connected with the Government Survey, the declination is noted at nearly every station. On average rough country, the figures stand at every possible value between 8° and $10^{\circ} 30'$, this being a range of one degree and a quarter to each side of the normal amount. The only section of the country I have ever found where the needle seemed to be absolutely uniform was on the long stretch of coral plain between Pearl River and Barber's Point. In other sections the range is small, say only half a degree each way.

Then there are localities where the needle runs perfectly wild, the lowest declination yet observed by myself, being 0° , and the highest 25° , the latter being in the immediate vicinity of magnetic iron ore, which was found by digging below the surface.

* *i. e.* in 1874.

In looking for any general laws to govern this matter, it appears that masses of earth in most cases attract the north end of the needle. Supposing a deep gulch running nearly north and south, with table land on either side. The north end of the needle on the ~~west~~ ^{east} bank of this gulch will be drawn to the eastward, causing a greater declination. On points on the Piiholo Gulch, Makawao, the needle read, according to the records 3° on one bank, against 12° on the other. On the ridge back of Puu Ohia, or Tantalus, Oahu, is the most marked instance on record of this fact, the needle on the edge of the pali overlooking Manoa Valley corresponding exactly with the true meridian, while about 500 feet distant, overlooking Pauoa Valley it points 16° to the eastward. Down in Pauoa Valley again, at the foot of the northwest *pali*, (which means, we would here remark, any steep mountain side or precipice), the declination runs down to 2° , or 7° less than the average. These are very rare cases however. On the northwest foot of Punchbowl Hill (Puu Owaina) the needle stands at 10° ; on the southeast foot at $8^\circ 30'$ in both cases evidently attracted toward the hill. I am satisfied that this is the case with respect to most of the lesser masses of ground.

Some singular exceptions to this rule occur in cases where large mountains are near by. At Lahaina, Maui, one would suppose that the mountain would draw the needle to the eastward. Instead of this the declination is less than usual, being 8° , and at Wailuku, on the other (east) side of the same mountain it is $9^\circ 30'$ as if repelled to the eastward; while on the low flat isthmus, away from the mountain, it will average about $8^\circ 30'$. The same repulsion from the mountain is noticeable at Oloalu, south of Lahaina. The Waianae mountains on this island, seem to have a similar effect, the declination along the coast of the Waianae District running down to 8° , 7° , and even 6° , on Professor Alexander's recent survey.

The Koolau range, as you approach it from either side seems to draw the needle into parallelism with itself. The great mountains of Hawaii have not yet been sufficiently studied to report upon. The Kohala mountain, Hawaii, attracts the north end of the needle.

This feature, of districts of varying declination, is probably the most difficult matter to deal with in compass surveying. Some of the districts have apparently no reason for their existence. For instance the portion of Honolulu from the Post Office to the river is a 10° district; the east portion of town is a 9° district; near Capt. Luce's again the declination rises to near 10° ; and at Waikiki beach goes down to 9° , rising again as you approach Diamond Head. Now in all this area, the needle appears to behave remarkably well. Probably the difference between foresights and backsights would not be noticed in ordinary work. It is only as one carries a true meridian series of sights over a long distance that the change becomes apparent. The cause must be either beds of volcanic matter under the sandy surface, or else the distant spurs of the mountain producing this effect. As to the theory of underground streams of water I have somehow little faith in it. They may possibly have an electric effect.

It will be seen from above, that for accurate work, the needle compass, set up at an independent station, i. e., unconnected with known lines, is absolutely *never* to be trusted. Moreover, how necessary it is to state what one means, when he states that a line bears N 40° E., or when he gives any other bearing. By what standard is it 40° ?

As to the *diurnal movement* of the needle, namely, its following the sun to the eastward from sunrise to 2 P. M., and then returning to the eastward every day, it amounts here to 8 minutes, and has little practical bearing on matters here treated of. It is well, however, to know that it exists. There are other vagaries of the needle, such as the lunar diurnal variation, and etc., known only in the sphere of magnetic observatory work, and entirely out of our present range.

NO. 12.

The third element to be attended to in respect to the magnetic compass surveying of the past years is the practice of the surveyors themselves, and the condition of their instruments at the time when used.

* dicated, characterized as the *local* needle, *initial* needle and *average* needle surveying. Now, if each employee of the Land Commission had been required to follow one particular method or, better, to *state what his practice was*, we should be far better off than at present. As it is, it is only by long trial and experience that we can find out the particular methods of each surveyor. One gleam of common sense appears on the record of survey of Webster's, viz., an appended note to this effect: "The bearings given agree with the needle only on the first and second stations of the survey, the others being laid off by their proper angles from these, the needle differing in some cases

In a previous number the different methods have been in two or three degrees from the bearing given." (Vol. 10, page 53, L. C. A. Records.) This signifies of course that Webster was an initial needle surveyor, in fact the only one. There is evidence that Turner followed that method sometimes, and sometimes did not. Even Webster sometimes seemed to change his meridian. I have endeavored in vain to gather from Messrs. Makalena and S. P. Kalama, who have done an immense amount of boundary measurement, what their own way of disposing of local deviation has been. The Hawaiian language in fact seems incompetent to grapple with the subject. *

On the Island of Hawaii, S. C. Wiltse, H. M. Lyman and the present writer, were "average needle" surveyors. Probably the other Lyman brothers also, who, however, can report for themselves. We are forced to the conclusion that most of the others, simply followed the local needle, trusting to luck to get their plots together. Metcalf was a very shrewd and practical man; his surveys have the merit of always exhibiting and referring to natural features for fixing the lines run. He made frequent marks too; most of the surveyors being very lax in this matter. In fact, when I am shown a buried bottle as marking a corner, I am always suspicious of it, as a late innovation.

It would be of great value to have a number of field books of each surveyor, stored away among the Government Survey archives. Any person who would furnish any such, of the old

surveyors, would be at least gratefully remembered. In all scientific work original records have a value much above what is generally supposed. One of these field books would generally show in some way the practice of the owner thereof.

With respect to the instruments used, the two Richardson brothers, who surveyed a large number of the earlier awards in the town of Honolulu, seem to have had very poor compasses, as the bearings seldom close. Their measured distances, however, were quite accurate, and generally furnish the means of locating their surveys, especially as they never indulged in that most execrable and lazy habit adopted by some, of not giving the last side and simply saying "thence to point of beginning." More of this hereafter.

With all Metcalf's care in other respects, he seems to have had a compass, that in sea phrase was "swung wrong," i. e., the zero of the plate was not parallel with the sights. So that its bearings were always about 50', or nearly a degree too much for northwest, and too little for northeast courses. Accordingly his surveys must be run with no allowances for secular change, and in fact with a little allowance the other way.* Most of the Land Commission surveyors were furnished with Gurley compasses which were new and quite correct.

No rule can be given for running out old surveys. It is delicate and responsible work, of which much must be done on the islands. Keen powers of observation, patience in comparing different surveys, and conscientious faithfulness, in addition to a knowledge of the facts indicated above, are the principal requisites. One rule should be to record all sights and measurements just as faithfully and fully as though it were new work. Never go into the field with a Royal Patent in the hand but have everything in the field book beforehand. Another rule, never express an opinion until satisfied in your own mind, as to the final decision.

With respect to new work, the faults of all the old methods should now be pointed out, and avoided. The "local needle"

* *i. e.* in 1874

method has only this to commend it, viz., the ease of setting up on the beginning of the line and running it provided you know it. Of course no correct plan can be made by it. And how about sides to whose corners the instrument cannot go? And no lines can be run backwards—a necessary expedient in many cases.

The “initial needle” method has this great drawback, that it necessitates going to the initial point. Now other points may be as perfectly known as that one, and in the case of large lands vary very much nearer. Another difficulty, two adjoining lands have, we suppose, different initial points, at which the local declination is different. Sides common to both must then, be consistent with their respective surveys have diverse bearings. Another difficulty is when the “march of civilization” brings a lamp post or water pipe or corrugated iron roof near the said initial point.

The “average needle” method is the best of the three, but is difficult of use because of the difficulty of determining said average. If the variation is given, one might as well use the true meridian, as it amounts to the same thing. Our next subject will therefore be some practical method of providing a uniform meridian for new work to be done hereafter.

NO. 13.

We now come to the question as to what standard of direction shall be employed in making new surveys in any part of the islands. The answer most certainly is, the *true meridian*. A timid policy would cling to the established methods, would suggest the difficulty and liability to error of establishing true meridian bearings; would fear, moreover, the confusion apt to arise from having two different systems on record. The confusion, however, cannot be greater than at present; and when one has once experienced the accuracy and confidence of procedure connected with true meridian work, he will be slow to return to the unsteady methods of the needle, of which its dancing on the pivot is a fit emblem.

There is only one other method worthy of notice. This is to take the bearing of a distant fixed point from the initial point,

and assuming said bearing to be correct, record it in the notes, and proceed to lay off all the other lines in the survey from this. The formula, then, for the description, would read like this: "Beginning at,whence by the meridian of direction adopted for this survey the highest point of Diamond Head bearsand etc." This is often times a good way when there is not time to do better. It is liable to two objections: One is, that trees are apt to grow up and houses to be built, cutting off the view; another, that more uniformity between different surveys is desirable than can be secured by this method.

How then can a true meridian bearing be ascertained by the ordinary surveyor furnished with only a compass with sights. With a theodolite, it may here be premised, the most practical course is to take one or more solar azimuths at some point, either on the line of survey, or connected therewith. With a compass, both of the two following methods are practicable, and not difficult. Every surveyor is supposed to provide himself with means for knowing the declination of the sun at any given time, and also the time when the Polar Star passes the meridian. Gillespie's Surveying gives the latter. The Abridged American Almanac is the most conveniently obtained source of information.

The first method is by azimuth observation of the sun, taken when it is either rising or setting, called generally an "amplitude." (*Azimuth* means simply *direction, specified by measuring around the horizon from some adopted point in the horizon.* In all great surveys this point is the *South* point, and the azimuth angle is measured around by the West, entirely around the circle, or up to 360° .) There are comparatively few localities on the islands where either the eastern or western horizon cannot be seen, hence the advantage of this method.

We will suppose ourselves at work on a tract of three or four hundred acres. Our camp for the night, or else the house where we stop should be in sight of some elevated point in the said tract. Call that elevated point an "azimuth station" and leave a flag on it. Just before sunset "set up" at camp, and

take the bearing of this flag, and record it. Then without removing the instrument, watching the movement when the center of the sun is just one solar diameter above the horizon, i. e., when the lower limb is one-half the diameter of the sun from the horizon, take the bearing of the center of the sun and record that. Now you have the angle between the azimuth station, whose true bearing you do not know, and the sun, whose true bearing you will find by the following simple rule:

From the logarithmic sine of the sun's declination subtract the logarithmic cosine of the latitude of the place. The remainder is the logarithmic sine of the angle between sun's center and due East or West.

The latitude is known with sufficient accuracy for compass work for the present maps. We have now the true bearing of the sun, and, from that and the included angle, the true bearing of the azimuth station. Now leave a flag where the compass stood, and the next morning go first to the azimuth station, and sight back on the known bearing. Then sight on some marked and well-defined distant point, and deduce its true bearings from the already known line. Record it carefully, and you now have a standard for the whole survey.*

The second method depends on the Pole Star using the azimuth station the same way. The books have a great flourish of plumb-lines, long poles, etc., with a waiting until the star is either on the meridian or six hours from it. Now no workman intends to sit up until midnight to wait for the star to pass the meridian, so set your watch by the corrected sun the day previous. If you stop at a house, tack on the gable end thereof a small staff, as large and long as an umbrella handle. Have it perpendicular. If there is no house, tack it on a tree. Just as soon as you can see the Pole Star, take out the tripod (only) of the compass. Set it so that to your eye held carefully above the center of the spindle whereupon the compass usually sets, the star will be hid by the staff on the house. That is, the three are in exact range. Note the time, and leave the tripod standing until morning, only "plumb down" and drive a peg as a precaution. Your table

* With a surveyor's transit the azimuth is obtained directly by computation from the altitude of the sun, its declination and the latitude.

gives the time when the star passes the meridian, and the watch the interval between the observation and the meridian passage either before or after. The appended table will show the corresponding difference in azimuth (for the middle latitude of this group) between the star and the true pole. In the morning range out very carefully the line of the night before. Its true bearing will be known from the appended table, and the transfer of this to the work required will be done in the same way as in the solar method above, one method indeed being a good check on the other.

TABLE FOR POLE STAR.
FOR 1874.*

Time Before Or After Meridian Pas.		Angle.		Time.		Angle.		Time.		Angle.	
H	M	°	'	H	M	°	'	H	M	°	'
0	10	0	4	2	10	0	48	4	10	1	20
0	20	0	8	2	20	0	51	4	20	1	22
0	30	0	12	2	30	0	55	4	30	1	23
0	40	0	16	2	40	0	58	4	40	1	24
0	50	0	20	2	50	1	01	4	50	1	25
1	00	0	24	3	00	1	04	5	00	1	26
1	10	0	27	3	10	1	06	5	10	1	27
1	20	0	31	3	20	1	09	5	20	1	28
1	30	0	34	3	30	1	11	5	30	1	29
1	40	0	38	3	40	1	14	5	40	1	29
1	50	0	42	3	50	1	16	5	50	1	29
2	00	0	45	4	00	1	18	6	00	1	29

NO. 14.

There have been published lately Solar Azimuth Tables, adapted to tropical latitudes, giving azimuths of the sun for every four minutes of time through the day. Furnished with these, and with a good watch one would have no excuse for using anything but a true meridian. They are published by Potter of London.

It will be asked now, how the work is to be carried along from a line of known bearing, through a succession of courses

* Diminish these angles 3 per cent for every ten years later than 1874.

and distances. With the "vernier plate" compasses, this should be done by turning the plate until the needle points to the true bearing of the known line sighted upon. Then when the compass is pointed on other lines from the same station, the needle will indicate their true bearing. Now when the surveyor goes to the next station he should sight back, and if the needle shows local deviation, turn the plate again until the true bearing is indicated by the needle. The plate will then be set for that station, and all bearings should be read from in that position. So go on, always working from a known line.

If there is no vernier plate, then there must be addition or subtraction, as the case may require, of the difference between the known true bearing and the apparent magnetic reading. This appears rather appalling at first, but is not difficult when one becomes accustomed to it.

A few more suggestions may be in place here as assisting in reducing matters to a little more uniformity and order. The matter of a *standard* of direction has been treated of. The triangle sides of the Government Survey, it is almost needless to say, furnish, wherever established, reliable measures of direction, and work, where it is possible, should be run from them. For a standard of *length* nothing is better than the modern steel fifty-foot chain, with brazed links. There are many reasons for adhering to the *foot* as the unit of length; and in this matter the writer speaks with full experience. The four-pole chain is not as convenient in the field, and moreover introduces, unnecessarily, a new unit of length, viz., "Link." It makes confusion wherever town and country work meet.

With respect to the French system of measures, I would say: Go not astray after the false god of the *metre*. The Anglo-Saxon foot is just as decimally convenient a unit; is far better proportioned to the human figure, and consequently to the size of everything we use, articles of furniture, lumber, draught of ships, in fact to more of our daily life than any one would at first imagine. What, under the metric system, is to be the carpenter's rule? What the chain? For metres are long and decimetres too short for convenience. When we re-

flect how extensive are the mechanical industries and architectural measurements of two such nations as the United States and Great Britain we shall see the folly of their endeavoring to change the foot for the metre. For the engineer the foot may be divided decimally and for the carpenter duodecimally. It would be an improvement to make the acre to consist of 50,000 square feet, and the statute mile, 5000 lineal feet. Then 500 acres would make a square mile, and a lot of 100 x 50 would be a tenth of an acre.

With respect to the matter of care in standards of length it may be remarked that a surveyor was once found by the writer using a four-pole chain *eleven inches* too long. This was not so strange either, as an opening of only one-thirtieth of an inch in each ring and link would produce this effect. It reminds me of a story of a Maui surveyor, who, when remonstrated with because his chain was a couple of inches too long, remarked: "That is queer; why I took out a link or two yesterday."

Perhaps nothing tests the business ability of a surveyor so much as the locating of the "initial point" so that it can be identified in future years with certainty. With the improved methods of measurement, it should be connected with some point not likely to be mistaken or to be moved, even if not less than half a mile distant. Illustrative of the fugacious character of points of supposed permanence—one of the estates adjoining this town started its lines from the middle of the end of a bridge. With rejoicing at the supposed certainty of "I. P." the boundaries were run out, and several apparently glaring errors detected in neighboring points. Eventually, however, it transpired that the old abutments of the bridge had been taken down, and in rebuilding, moved some sixteen feet, thus upsetting all theories of locality founded upon said abutments. Probable permanence, therefore, becomes a very important element in selecting points of reference. Distance and bearing from a near point, with bearing to some very distant sharp point is the best combination. Waterfalls are especially marked and permanent objects.

The most available material for marking corners—a most important duty—is a sunken stone, easily seen, with a buried one beneath it. On both should be clear cut characters, cut with a cold chisel, and with some uniform method of location and marking peculiar to the surveyor himself, to prevent counterfeiting. Where there are no stones, carry bricks on a pack animal and having marked the surface with a trench—a Maltese cross is the best shape, as giving a definite center—bury the well-marked brick in proper position below. Bottles are too common, and so are false marks.

The whole line should be described by bearings and distances, even when it is a gulch or line of coast, or a ridge. It is not sufficient to say, "Thence along the shore to point of beginning." For one reason, there should always be a check to the work which can only be furnished by a *complete chain of courses* around the whole piece. For another reason it is often desired to plot the land from the notes in connected district maps. It is not, however, proper to closely follow the crooks and turns, in said notes. The best way is to connect prominent points in ridges, coasts and gulches, and give the direct course and distance from one to another, adding the formula, "the middle of the gulch" (or top of ridge, or high-water mark as the case may be) "being the boundary." In fact, no survey ought to be accepted, either by land owners or by the Government, that does not thus locate every salient point of the boundary, and at the same time prove itself.

NO. 15.

It should be understood that there is no intention in the remarks made in the preceding articles to disparage the procuring and use of the better class of instruments. The aim has solely been to suggest to those who are occasionally engaged in the work, better methods than are likely to be found in books, and to land owners some hints as to whether work done for them is properly done or not. There have lately been in this town two expensive lawsuits, originating in de-

fective surveying—a cause and an effect both desirable to avoid.

The best generally used instrument for all kinds of work in this line is the *five-inch transit theodolite*, either the American form known as the “Surveyor’s Transit” or the corresponding English one, made by the leading instrument makers of that country. My own experience favors the latter. The “Solar compass” has some drawbacks connected with its use.

It could be wished that the “azimuth system” of recording bearings were introduced in all descriptions by survey. By this system West is 90° ; North 180° ; East 270° ; all intermediate bearings accordingly. Thus N. 80° W. is 100° ; N. 80° E. is 260° and S. 80° E. is 280° and so on. One speedily becomes accustomed to associating in the direction with the figure. The advantages are numerous; in the first place, a great saving of brain labor. The labor of recording is far less, the corrections are uniform, the magnetic azimuth being *always less* in this country than the true. The liability to error by copyists is very much less, one of the most frequent errors occurring now-a-days being the substitution, for instance, of S. 89° W. for N. 89° W. and *id omne genus*. It would not be best to introduce it at present, except in giving sights to distant objects, which would accustom observant people to its use.

It is a commendable method to write out or “engross” the notes of survey on the sheet of drawing paper containing the map. Many notes have been lost in consequence of the common method of writing them on a separate sheet. It is somewhat laborious to engross them, but it pays in the end.

Notes of survey should be concise but full, without a single unnecessary word, such as the customary one, “Beginning at the south angle of this”—of course the notes themselves show that it is the south angle. The introduction of the following specimen from an actual case, may be pardoned on account of the combining therein of the different needed elements of certainty:

“Beginning at a rock marked with an arrow, N 17° E true, 250 feet from the head of a waterfall on this land, ”Trig. Sta-

tion No. 2, of bearing $259^{\circ} 46'$ true, distant 4205 feet, and the sharp point of $211^{\circ} 00'$ (N 31° E) the local declination being $7^{\circ} 30'$ E, and running as follows:

1—S $35^{\circ} 50'$ E true, 360 feet along, ” etc.

It will be seen that—first is located the particular spot on the ground; second its place on general maps; third, to a future surveyor coming on the ground on a cloudy day, an immediate means is afforded of fixing the meridian; fourth, the local declination gives a means of finding the peak referred to.

It is not a good way to give both the true and magnetic bearings of the same line. Either one or the other, giving preference of course to the former, always stating which it is that is used. The exact original wording of the surveyor should be always preserved in all documents that embody the same description within themselves.

There are many maps on file in the Interior office that give neither the date nor the name of the author, often times not the name of the district, even the name of the land itself being omitted in a few cases. Everything should be given in full, even the person for whom the survey is made, and the number of the Award or Patent covering it.