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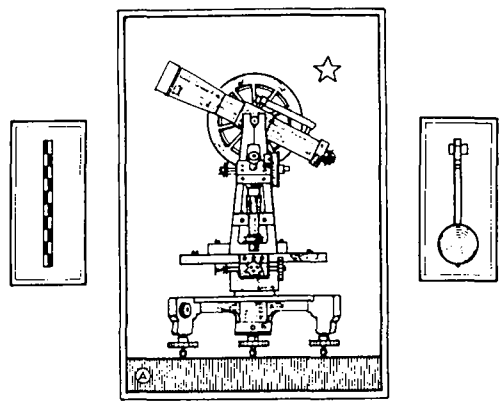

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G E O D E T I C L E T T E R

JULY - AUGUST, 1935

Volume 2 Number 7

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BANNER YEAR FOR GEODETIC SURVEYS

The fiscal year beginning July 1, 1934 and ending June 30, 1935, was by far the most important one for geodetic surveys in the United States of America. More work was done during those twelve months than for any previous period of that length.

For many years the geodetic surveys were carried on in a very small way. Prior to 1916 the appropriation for field expenses was $31,000 a year. This was increased by varying amounts until in 1920 it had reached $100,000 and it was continued at about this amount for 10 years.

In 1930, the appropriation for field expenses was increased to $327,000 and in 1932, through funds obtained from the so-called Wagner Bill, the total amount available for geodetic work was approximately $500,000.

In 1933, a large amount was allotted by the Public Works Administration for geodetic or control surveys. This fund of over $2,500,000 was practically exhausted early in January 1935 when an additional allotment of $900,000 from public works funds was made to take the work up to June 30, 1935.

During the past few years the regular appropriation for the geodetic surveys has been gradually reduced until for the fiscal year 1935 it was only $131,970. However, this reduction was not felt because of the great amount of public works money made available for the control surveys.

Not only has a larger amount of money been spent on geodetic surveys during the past twelve months, but the unit costs have been reduced. We do not have available the unit costs for the fiscal year ending June 30, 1935, but the average cost per mile of progress in the triangulation and leveling for the past two years is 12 percent less than for those classes of work during the fiscal years 1931 and 1932.

We also have the very fine record of having maintained the accuracy of the work. Our standards are high and have always been so. They are at least equal to the standards for geodetic surveys set by the International Geodetic Association.

We wish here to pay a tribute to the personnel that is now engaged on geodetic work, both office and field. There are 1400 persons now engaged on this work. Most of them scarcely knew three or four years ago that the Coast and Geodetic Survey existed. The new personnel has supplemented the small nucleus of

what we generally term the regular force. The new personnel, office and field, has been given intensive training by the chiefs of party and chiefs of sections. Practically all of the observing in the field is now done by the new engineers and others. The chiefs of party have their hands full in training personnel, planning the work, managing the accounts, equipment and many other things. They have no time to spend at the instruments but they have been very clever and able in imparting their knowledge of the observing to their assistants.

Not only have these new men made the observations but they are able to take off at some distance subunits of the large geodetic parties and handle the job independently of the chief. They only have occasional inspection from him.

In the office there have been many of the new personnel who have learned to make the least square adjustments and even to lay out the equations for such adjustments. They are preparing intricate data for publications which will furnish the results of the geodetic surveys.

At the time of writing this, we are working on an emergency allotment sufficient to carry the field and office work through the month of July, 1935. It is hoped that during this month final decision will be made as to the amount of funds that will be allotted by the President or his advisors for the coming twelve months.

Since the geodetic or control surveys are now going along somewhat faster than the topographic mapping, it may be asked whether this is desirable. While the control surveys done by this Bureau form the basis for all topographic mapping, the data secured have many other uses. There is scarcely an engineering operation that does not depend for its proper execution upon a knowledge of position, distance, direction and elevation. This information is furnished by the control surveys. In addition to furnishing such a vast quantity of material which is of value in carrying on the many activities of our people, we are keeping many engineers and others employed who otherwise would be seeking work. They are being trained in higher surveying and when times become normal and many of them go back to private work, they will be better engineers as a result of their training and experience, and they will never be willing to do a poor surveying job.

Whether the geodetic surveys carried on now on a large scale will be continued in the years to come as the depression ends, no one knows; but in any event, it is an "ill wind that blows no man to good" and the country is better off for having had funds spent on these geodetic surveys primarily to relieve unemployment.

THE BEGINNING OF THE COAST SURVEY

Richard West

(Reprinted from the United States Naval Institute Proceedings of May, 1935, by courtesy of the Editor.)

The year 1935 marks the centenary of one of the Navy's greatest peace-time services; a service which was a considerable contribution to science, and one which, because it immediately saved the mercantile interests of New York the estimated $50,000 per annum they were accustomed to lose in shipwrecks on their own coast and promised similar savings to other coastal regions in the near future, quite naturally gained widespread good will for the Navy generally. This important service was the discovery in 1835 of the "main ship channel" or the "Gedney Channel" into New York Harbor by Lieutenant Thomas R. Gedney, U. S. Navy, attached to the Coast Survey schooner JERSEY. Since the new channel was 2 feet deeper than any previously known, its discovery meant that larger merchantmen could now cross the bar into New York. After Lieutenant Gedney and his assistants had buoyed out their deeper channel, such inbound sailing vessels as happened to be caught by heavy southeast winds had at least a sporting chance to make their way safely into port. The convergence of the coasts of Long Island and New Jersey and the scanty depth of water in the previously known channels had exacted a good-size toll from shipping, and the shore lines leading to the busiest port in half the globe were regularly strewn with wrecks. With the growth of America's Merchant Marine the casualties had increased; and the sudden prospect of staunching this steadily growing loss made an irresistible appeal to the mercantile interests. The grateful merchants influenced their Congressmen; and the latter were led to grant additional favors to the Coast Survey, which happened at this moment of its hectic career to be a child by adoption of the Navy Department. The discovery of the Gedney Channey in 1835 acted like cod-liver oil upon the struggling and anaemic infant, the Coast Survey, as a brief resume of its early history under its erratic Superintendent Ferdinand Rudolph Hassler will reveal.

On February 10, 1807, the Congress that voted President Jefferson's notorious gunboats and his embargo and non-intercourse acts also passed a very creditable law authorizing the President to establish a coast survey. Why President Jefferson requested the law is not known. The unfortunate grounding of the U.S.S. Philadelphia on the Kaliusa reef off the coast of Tripoli in October, 1803, which had so woefully embarrassed America in her war against the Barbary corsairs, might have offered the suggestion. Perhaps while he was Ambassador to France, Jefferson had learned of the advanced state of geodesy in that country, for the French

were so highly conscious of the value of surveys that competent technicians with compasses and theodolites had moved out beyond the French frontiers in the wake of the Revolutionary armies. At any rate Jefferson requested the law and Congress gave it to him, along with entire responsibility for executing it.

Through his Swiss Secretary of the Treasury, Albert Gallatin, Jefferson got in touch with Professor Hassler, also a Swiss, who had recently been driven to America by the revolutions in his native land. Hassler was a learned jack-of-all-trades. Educated in astronomy in Paris and Göttingen, he had risen high as a lawyer and judge in his fatherland; applying his mathematical knowledge, he had in 1791 laid down the primary base line for the triangulation of Switzerland. Hassler's plan for triangulating the Atlantic coast was approved by President Jefferson, and he would have been sent at once to England to purchase surveying instruments and technical books on the subject had not H.M.S. Leopard insulted the United States on June 22 by pouring a number of angry broadsides into the ill-prepared U.S.S. Chesapeake a few miles off Lynnhaven.

War between the United States and Great Britain seemed imminent. His trip to England indefinitely postponed, Hassler became a professor of mathematics at West Point and at Schenectady until 1811 when President Madison sent him to London to get his surveying equipment. The War of 1812 hedged the unlucky professor about with difficulties, chiefly financial, and kept him in London until the fall of 1815, when he was compelled to borrow money at 20 per cent to get his equipment out of the country.

When he got home in 1816, Professor Hassler made his financial arrangements with Secretary of the Treasury Dallas and moved his equipment to Newark. New Jersey. It had been decided to run the first base line in New Jersey because of its central position, after which the survey could be extended to the north and to the south. To expedite the work Professor Hassler had also moved his domestic establishment to Newark. Secretary Dallas had assured him that his place of residence would not matter. But Professor Hassler had scarcely left Washington before Secretary Dallas left the Treasury. Mr. Crawford, his successor, according to Hassler's account, "immediately began by refusing any funds to set the work in activity, so that I had to begin it with my private means."

If the new Secretary was slow in meeting the obligations incurred by his predecessor, Professor Hassler was too wrapped up in his own work to bother greatly about such mere details as money. He spent his own money and assumed that everyone was as anxious as he to get the Coast Survey started. One of the expenditures he incurred was for a monstrous box-like carriage for transporting his theodolite and other instruments, his books and journals, his trunk full of clothing and blankets, his Swiss wines and cheeses,

and his tinkling music box that could play only foreign tunes. As he traveled through rural New Jersey he gained notoriety as a "character". Winter and summer he wore white woolens, which he stoutly argued were as good for warding off heat as cold. He needed spectacles but refused to get them, preferring to stimulate his vision with pinches of snuff, which he carried in the pockets of his vest. Although the government allowed him $2,000 for his extra expenses, he was continually haggling with innkeepers over exorbitant prices. More than once he argued himself into a lawsuit. Along with his surveying, he indulged his flair for astronomy, and made elaborate preparations for observing eclipses. For two seasons (1817 and 1818) the professor worked in the obscurity of the Jersey coast and his home in Newark. To assist him he had three army officers one of whom had been a favorite pupil at West Point, one or two drivers, and woodsmen to clear away trees and brush. Under the circumstances the work progressed very slowly. By the beginning of the second season no maps had been published, and officials in Washington became impatient. On April 14, 1818, while Professor Hassler was giving the finishing touches to his annual report, Congress suddenly took matters in hand and amended the law of 1807 so that only officers of the Army and Navy could be employed in the Coast Survey. President Monroe tried to soften the blow to Professor Hassler by appointing him to the commission to survey the northeastern boundary line. The professor nursed his wrath in public and in private during the remaining 25 years of his life; but when Andrew Jackson entered the White House and the Coast Survey law in 1832 was modified to permit Professor Hassler's return to his old job, he took up the work with unabated zeal; he exulted in the fact that the fledgling democracy had been compelled to recall old-world science to her assistance.

During the period from 1818 to 1832 both the War and the Navy Departments had co-operated in the survey of the coast, and for lack of highly specialized scientists, both had failed to produce reliable results. Secretary of the Navy Southard in April, 1828, reported to the House Committee on Naval Affairs:

Of the whole of the maps and charts in possession of the Government, it may be remarked, that they do not furnish a satisfactory survey of the coast for the following reasons:

(1) They exhibit detached parts, unconnected with each other.
(2) Are generally confined to the shores, and do not extend sufficiently far into the ocean.
(3) Many of them were made by incompetent men, with incompetent means.
(4) They were governed by no fixed and certain principles or guides, in ascertaining the latitude and longitude of the principal points and positions.
(5) They do not embrace the whole coast.

For these and other reasons, they are unsafe, and in many instances, useless and pernicious.

While to a certain extent the law of 1832 marked a return to the original law of 1807, it was not a complete return. Responsibility for the Coast Survey was placed with the Treasury Department rather than the President. In March, 1834, however, it was transferred back to the Navy. Professor Hassler, a stubborn and unbending gentleman of 62 years, regarded this change with disfavor, and continued to manage the affairs of his office as he had formerly done, and with no very polite regard for the Secretary in whose department he was now placed. Without consulting the Secretary he purchased for the survey the outlandish carriage which he had had constructed in 1816, and had it repaired. Repairs for the 16-year-old vehicle were necessarily extensive; and this, along with the fact that the professor himself had been the owner of the contraption, caused anxiety in the office of the fourth auditor in the Treasury Department. Without consulting the Secretary, Professor Hassler hired drivers for his pet vehicle and in it made long trips between his home in Washington and the scene of his labors in the field. He was amazingly impolitic in proclaiming the virtues of his ugly carriage. The few miles of railroads, of which Americans were inordinately proud, were uncomfortable and unsafe, according to Professor Hassler, and on one occasion had jolted all the screws loose in his surveying instruments. The steamboats, which offered the cheapest transportation available, were manned, according to Professor Hassler, by thieves and rascals. At Baltimore they had lost a trunk containing his personal effects, and he was determined not to risk the precious instruments and notes of the survey in their charge unaccompanied by a responsible member of his staff. Apparently in the eyes of the old Swiss nothing American was good. When he insisted on importing Swiss wines and cheeses he infuriated native American producers of those articles. When he sent to Hungary for copper plates for his engravings he infuriated the merchants of Philadelphia; and when he sent to Hamburg for skilled engravers he aroused the ire of native American engravers in Washington who were accustomed to receive the patronage of the government. Washington overlooked Professor Hassler's idiosyncrasies for the simple reason that he was indispensable to the survey.

By 1832, the markers along the original base line in New Jersey had almost entirely disappeared and a new base line was begun on Long Island. Professor Hassler himself performed the primary triangulation, which consisted of laying out triangles of from 10 to 50 miles in length; and parties of assistants filled in the large triangles with secondary triangulation. Each party of assistants was under a naval lieutenant especially selected by Professor Hassler and detailed by the department to the Coast Survey. The parties included from four to six midshipmen, as well as drivers, woodsmen, and messengers who were temporarily hired for the work as needed. Rear Admiral B. F. Sands, who as a midshipman spent several years in the survey, gives an interesting account of the nomadic, outdoor life of the surveying parties in <u>From Reefer To Rear Admiral.</u>

Lieutenant Gedney, assigned to the Coast Survey in October, 1834, as commander of the Survey steamer Jersey, gave before a congressional committee of investigation in 1843 a concise description of the work of the parties ashore. A system of flag signals was devised. As soon as the shore party had fixed three stations, and measured distances along the land bases, two officers aboard the ship would be prepared to measure the angles between the points on shore. Simultaneously, when the signal was given, soundings would be taken and angles would be measured. Work in the field was carried on from April or May to November or December, depending on weather conditions; then during the winter months the surveyors would go to their respective homes, each being assigned by Professor Hassler a certain amount of work to do in plotting and co-ordinating the data secured during the months in the field.

Up to 1835 the annual appropriation varied from $20,000 to $30,000. The work was seriously handicapped for want of sufficient funds. Professor Hassler's allowance of $2,000 in 1816 for extra expenses had been pared down in 1832 to $1,500; and according to his own testimony he regularly spent $3,000 for this purpose. The survey had no established quarters wherein to carry on the enormous amount of mathematical work during the winter. And every spring when field work was resumed the surveyors would find that the people of the countryside had removed some of the markers so that much of the previous year's work had to be redone in the process of checking the winter's plotting. Under these circumstances it is not surprising that the Survey failed to publish maps and give tangible justification of its existence. Moreover, Professor Hassler's relations with the Navy Secretary and the fourth auditor were extremely cool. Quite naturally neither of the officials appreciated the professor's classroom manner of treating them as ignorant schoolboys. In 1834, when Secretary Levi Woodbury made a tour of New York he ignored Professor Hassler's earnest invitation to inspect the progress of the survey of Long Island. In a letter complaining of this slight it appears that Professor Hassler had been much interested in impressing the people of the countryside with the importance of his work so that they might be induced not to molest his signals.

The discovery of the Gedney Channel into New York Harbor in 1835 marks the real beginning of the Coast Survey, for it was this discovery which "sold" the survey to the merchants of New York, to members of Congress, and to the American public generally. At once Congressmen from the other coastal states requested that similar surveys be undertaken immediately in their states. Maryland offered to defray the expenses of surveying parties on shore if the national government would detail a naval party to perform the maritime part of the task. A Congressman from North Carolina made strenuous overtures to have the harbor of Beaufort accurately mapped.

The doors of the Treasury Department were suddenly unlocked for the impecunious Professor Hassler. His allowance for personal expenses in 1835 was $1,500. In 1836 it was doubled, his total compensation, $6,000, being equal to that of the Secretary of the Treasury himself. At the beginning of 1835 the Coast Survey had not even a house for its winter headquarters; after Gedney's discovery Professor Hassler was allowed to lease two houses, two row houses in Washington adjoining the Bureau of Weights and Measures, of which Professor Hassler had been chief since the beginning of President Jackson's rule. For 1835 the total appropriation for the Coast Survey was $30,000; in 1836 it jumped to $80,000, two years later to $90,000, and in 1840 to $100,000. The Coast Survey had now become a fad as much as the post roads or the canals of the period, which appealed so strongly to the commercial instincts of the American public.

Professor Hassler was even indulged in another of his whims which he had long agitated. The Survey, to whose success the Navy Department had contributed so largely, was transferred from the Navy Department to the Treasury; although naval officers and naval vessels continued to be detailed to its service. The red tape of the Navy Department, Professor Hassler had contended, was peculiarly demoralizing to a scientific enterprise so non-military in character.

Unfortunately, the much anticipated scientific results did not, or could not, keep pace with the favors Congress had so quickly bestowed upon the Coast Survey. Professor Hassler was now 65 years old, and more set in his ways than ever. Year after year went by. The survey stretched northward beyond New Haven and southward to the head of Chesapeake Bay, but no maps were published.

In 1841 Congress became restive and ordered an investigation. Professor Hassler wasted most of the summer writing refutations of charges of irregularities made by the fourth auditor, and charges of unnecessary delay which were made by impatient Congressmen.

As a matter of fact, many of the charges against Professor Hassler were well grounded. His faculty for argument enlarged with age and became a sort of "defense mechanism". After 1835, Professor Hassler's health had begun to break. He lost more and more time because of illness, and the swampy tidewater country disagreed with him more and more. In 1841 he boasted proudly that the secondary triangulation had now extended over 11,000 square miles of coast line; but he minimized the fact the primary triangulation, which he allowed no one but himself to perform, had covered only 3,700 square miles, about a third of the area already covered by his assistants in charge of the secondary triangulation.

When the old man's eyes began failing him, he had an assistant look through the telescope for him and refused to allow anyone else to share this part of the work. Since the primary triangulation provided the check for the secondary, the work of making maps was unnecessarily delayed.

In 1842 Congress appointed a committee to investigate the Coast Survey. Professor Hassler regarded the move as a personal affront to himself. The chairman of the committee sent one Mr. W. J. Stone, an engraver of Washington, to request Professor Hassler to send the maps of New York Harbor for the committee to examine. Regarding Stone as a competitor, and perhaps the chief instigator of his troubles, Professor Hassler abused him, as well as the committee, with great violence, and if he had not been restrained by his assistants would undoubtedly have kicked Mr. Stone downstairs out of his office.

Cross-questioned by the committee the professor proved an unruly and incommunicative witness. What the committee could not understand was why the professor should delay all publication till the whole was completed; why he had to measure the ellipticity of the earth before allowing a practical mariner's chart of New York Harbor to be printed.

The investigation was exceedingly painful and the members of Congress rubbed Professor Hassler decidedly the wrong way when they assayed to measure his imported copper engraving plates with a carpenter's rule! The struggle between the lawmakers and the beligerent and incommunicative scion of old-world science was terminated by the death of the latter in 1843. For all his personal stubbornness, Ferdinand Rudolph Hassler had laid the basis for one of the most important scientific agencies of the government. Throughout the turbulent years of Professor Hassler's superintendence of the Coast Survey, the peace-time Navy had participated nobly in the enterprise. Many naval officers had received a scientific training which was to be immeasurably useful to them in the war between the states. One of these fortunate officers was destined to become admiral, one vice admiral, and two others rear admirals of the Navy.

When Professor Alexander Dallas Bache became superintendent of the Coast Survey in 1843, the organization had passed its period of hectic experiment; its foundations had been well laid. Much of the work performed in these early years was so carefully done that it has retained its authoritative character throughout the hundred years of progress which have followed the first gala year of the Coast Survey.

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IDENTIFYING AND NAMING OLD SURVEY STATIONS

One of the important uses of the national control surveys is the coordination and correlation of detail surveys, past, present and future. For future surveys the burden of use rests upon the engineer making the detail surveys. It is his duty to know and make use of the control stations that have been established in the region in which he is working. For surveys under way at the present time, the engineers working on the different classes of surveys,- control and detail, must get together and cooperate to the fullest extent. Where old surveys are to be benefited by the control surveys of the country, as a rule, it is incumbent on the geodetic engineer executing the control surveys, to recover, identify and properly tie in the marks of the old surveys. Of course, it cannot be considered practicable for the observing party to delay too long while search is made for marks set by other organizations, but the reconnaissance man usually has data needed for recovering and identifying marks set by other bureaus of the Federal Government in the territory in which he is working, and he should make a thorough search for them. Such marks are often recovered in positions near stations of the new or control survey which makes their determination a matter of ordinary routine.

However, the records received at the office do not always show a proper appreciation of the importance of accuracy both in identifying such survey stations and in connecting them to our triangulation stations. Possibly the engineer in the field makes what he considers a close recovery of the old station and if it be a U. S. Geological Survey station, he evaluates the recovery in terms of the scale unit of one inch to the mile, considers the recovery perfect for use on the base topographic map of the country, and calls it an unqualified recovery. He may give it the name of the characteristic topographic feature of the locality, and put the initials (U.S.G.S.) after it to indicate the recovery of a Geological Survey station. As far as such reasoning goes, he may be correct; but when the topographic engineer wishes to adjust a traverse of a previous year to a standard position of his station, a discrepancy of a few feet may make his closure untenable and put him "up in the air" insofar as being sure of his detail control. So what the geodetic engineer has determined is really a new station, which is, in his opinion (backed by some evidence and good judgment), very close to the position of an old station. This being so, he should give it a new name, and let the description carry the story of approximate recovery.

The reconnaissance engineer is supposedly furnished with complete data relating to old stations of other bureaus within the area in which he is working. This is especially true with reference to stations of the U. S. Geological Survey, and it is with the editing of descriptions of these stations that many of the

difficulties of identification and proper naming are encountered. These difficulties take the form of such questions as, "Is this a U. S. Geological Survey station or a new station?" If the answer is that it is a Geological Survey station, then comes the next question, "By what name did the Geological Survey call it?" The reconnaissance man probably knew, and perhaps he put it in his description. If he did, and indicated that such was its true name, all should be well, but if the name he gives it is different from the old name and he adds (U.S.G.S.) to it, then some unscrambling will have to be done. What should the reconnaissance man do if he does not know the original name with sureness? It is here suggested that he give the station a new name, and in his description state that it is identical with a U. S. Geological Survey station, name unknown.

The observing party should remember that the reconnaissance descriptions are written only for the use of the observing party, and should take care that the descriptions and recovery notes sent to the office contain all the necessary information furnished by the reconnaissance party. It is not sufficient to say, "Recovered as described by the reconnaissance party". Often a description or recovery note of an old station is received in the office with no mention at all of the old marks which were found, yet an examination of the reconnaissance description reveals that it contains a complete description of the old marks. This often leaves doubt as to whether the observing party re-marked the station, or established a new station.

As to accuracy of the connection of the old station with the new or control station:- If the connection is worth making at all, it is worth making with a certain degree of accuracy. Because a cairn is the only mark discovered at the site, to pace the distance and estimate the direction or determine it with compass, is valueless as a connection. It will help one recover the newer station if he finds the older one, but it will not satisfactorily coordinate the old and new surveys. It is recommended that one flag the center of the cairn, and determine the distance and direction of the flag from the control station with the same precision that is used in making reference mark connections. But describe the cairn with care, and look for more definite marks under and around it.

IN ALL CASES OF RECOVERY OR APPARENT RECOVERY OF AN OLD STATION, DESCRIBE WITH CARE AND EXACTNESS WHAT OLD MARKS ARE FOUND, AND IF ANY CHANGES ARE MADE IN THOSE MARKS, EQUALLY ACCURATE AND COMPLETE DESCRIPTIONS OF THOSE CHANGES SHOULD BE MADE. IT IS OFTEN OF AS GREAT IMPORTANCE TO KNOW WHAT MARKS WERE FOUND AT AN OLD STATION, AS IT IS TO KNOW WHAT MARKS WERE LEFT THERE.

POINTS TO BE CONSIDERED IN SELECTING A LAPLACE AZIMUTH STATION

C. A. Whitten

When a member of a triangulation party recommends that a certain station should be used as a Laplace azimuth station, there are certain things which he should bear in mind. Of course, it is not expected that the ideal place will ever be found, but it is possible to choose stations which will fill many of the suggested requirements listed below.

The station should be accessible by truck. The equipment of an astronomical party is heavy and cumbersome. Any pack would only add expense and delay the operation of the party.

The station site should be on cleared land. It should never be close to buildings. Air currents moving about buildings cause unusual refraction. Frequently stations have been selected at which the line of sight to Polaris is not clear. The observer should be able to see Polaris from the ground at the station. The line of sight to the star should never pass over any buildings in the immediate vicinity of the station.

The selection of an azimuth mark is very important. When possible, a main scheme station should be used. When this is not possible without excessive building, an additional mark is set. It must be kept in mind that the astronomical party is working from the ground and that lines of sight along highways or railroads, should generally be avoided because of possible refraction. An ideal place for the azimuth mark is a light posted on a water tower or other permanent object that is visible from the ground at the station. A drill hole is sufficient to mark the point.

The mark should not be less than one mile from the station and should preferably be two or three miles away. In rare cases it has been found necessary to place the marks at distances less than that. In such instances great care should be used in collimating the instrument. It should be needless to state that the light used at the azimuth mark should be carefully centered. However, recently an azimuth mark was recovered which showed that the light had been carelessly set. The light keeper had apparently set the light on the mark while the concrete was still soft. When another light of the same size as that used by the triangulation party was set in the imprint left on the mark, it was found that the center of the light was off-center three-sixteenths of an inch. In this case the mark was only a mile from the station.

It is preferred that the azimuth mark be placed so that it

is easily accessible. On one occasion it was necessary to drive 65 miles over very rough roads for a round trip to the azimuth mark. In some instances it has been necessary to hire boats to reach the points. This not only delays the party but adds to the expense.

The description furnished the office should clearly state the height of stand needed at each mark. If any clearing is necessary it should be stated in this description. When the description says a 4-foot stand is sufficient, the party takes material for such a stand to the mark. Recently the party occupied a station at which a 4-foot instrument stand and 15-foot light stand were required according to the description. When the two points were recovered, it was found that a 30-foot instrument stand and a 40-foot light stand would be needed. At the same station it was possible to see a water tower from the ground. The latter could have been easily used as an azimuth mark. The description should contain a list of directions, including the Laplace azimuth mark and the reference marks. In case the azimuth mark is a main scheme station, the direction to the Laplace station should be included in the description.

The accuracy of the observations made by the triangulation party is important. Since the special mark is not observed from more than one station, there are no checks on the observation. It is suggested that the sum of the residuals of the individual positions should not exceed 26.0 if 16 positions are used. If 24 positions are observed, the sum should not exceed 44.0. If this rule is followed the observations will have about the same accuracy as those made by the astronomical party.

The members of the astronomical party are not looking for soft jobs but are only seeking more efficient ways of operating the party. With the cooperation of the triangulation parties along the lines suggested above, the astronomical party will make greater progress and the cost per station will be much less.

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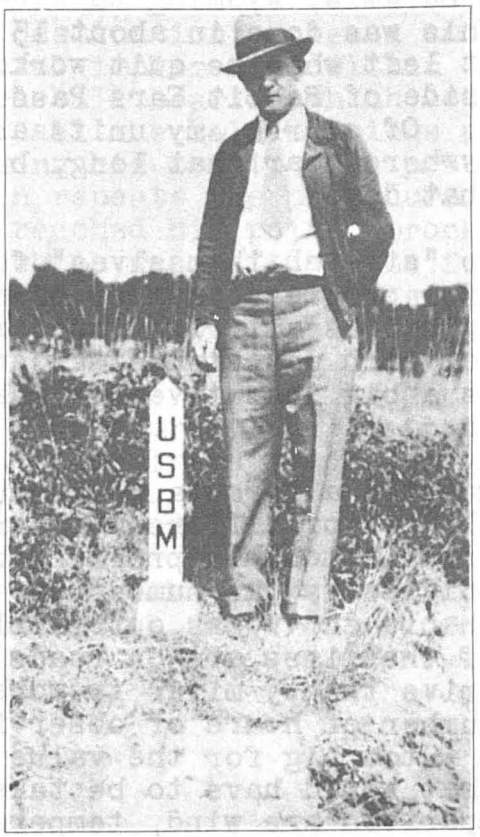
STATE HIGHWAY DEPARTMENTS ERECT GUARD POSTS BY COAST SURVEY BENCH MARKS

As an indication of the growing interest in the perpetuation of the level bench marks, the State Highway Departments of Iowa and Oregon have erected guard posts by each mark along the highways to protect them from passing cars. These bench marks are of especial value to engineers but they are also of interest to motorists and others who desire to know how high they are above sea level. These elevations in most cases are shown on the marks. However, if the elevation has not yet been stamped on the mark, this information can be obtained by writing to the Director of the U. S. Coast and Geodetic Survey, Washington, D. C.

Since these guard posts do not in any way mar the scenery, it is hoped that the highway departments of other states will follow the example set by Iowa and Oregon.



Oregon State Highway Department
Standard Bench Mark Guard Post.

The 116 foot leaning tower.

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THE LEANING TOWER

The April, 1935, issue of the Geodetic Letter carried an article about a steel tower, 116 feet high at POST-1933 (Washington, North Carolina) which, after remaining in collimation for two days, began to lean due to the soft mud giving way under the footings. The picture shown at the right above will give an idea of the extent to which the tower was out of the vertical position before its tilt was finally checked.

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LEVELING NOTES

A. L. Wardwell

What is believed to be a leveling record of some sort was made on my party last summer by S. Y. Symns. On July 14, 1934, observing on the first-order line from Laramie, Wyoming to Sidney, Colorado, he made 417 set-ups. This was done in about 13 hours, there being one hour of daylight left when he quit work. That part of the line was on the west side of Rabbit Ears Pass on an even grade about nine miles long. Of course, my units are not in the habit of putting in days anywhere near that long, but these boys made a special effort for that day.

I do not encourage my observers to "stretch themselves" for the purpose of hanging up some record for progress, number of set-ups, etc., on this second-order work. That is all right on first-order work where a check must be made of each day's running, and I think that the idea of checking in is a big incentive for making properly careful readings.

Last year one of my recorders suggested a formula for securing a comparison of the respective abilities of different observers. His idea was to multiply an observer's monthly progress by his number of instrument set-ups, and divide by the number of days actually worked. It sounds reasonable and works out fairly well, but in this region, where some of the lines are on roads where it takes two or three hours to drive twenty miles to work, it would seem necessary to count the number of hours of observing, instead of days, and that is a big job - too big for the value of the results obtained. Other matters that would have to be taken into account for a really accurate comparison are wind, temperature, and the condition of the line underfoot; whether railroad bed, paved road, muddy road, or trail. In fact, there are so many variable factors that I have given up trying to make a mathematical comparison of observer's abilities. I would like, however, to see what other chiefs of leveling parties have to say about any such method.

The bad roads and the great amount of time lost on account of rain and snow here in California this past winter make my progress for the last several months look like "small potatoes" when compared to the reports from parties working in flat and easily accessible regions.

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BALL BEARINGS AS TURNING POINTS IN LEVELING

The letter given below was received from Mr. E. J. Helin, who is attached to the party of Mr. W. W Studdert. Mr. Studdert has been instructed to try out the method outlined and report on it. Comment from the field is invited.

"I am herewith offering a suggestion which may be of value in adding to the efficiency of the level units.

"My idea is to eliminate leapfrogging when working along certain types of highways with the aid of a ball bearing turning point. The ball bearings are placed in smooth cut grooves or perforations by the front rodman.

"This would work as follows: The front rodman when reaching his destination, makes a smooth cut groove with the aid of a special implement. Within this depression he then places a sizable steel ball bearing which acts as a turning point. It is understood that all the ball bearings are of the same size. The rodman after marking his point, will proceed forward to his next point where he again repeats the procedure. In the meantime, the rear rodman having reached his point, proceeds holding his rod on the ball bearing which was left by the front rodman. As soon as the back rod is read, the rodman picks up the ball bearings and proceeds to the next point. Obviously therefore, the front rodman must carry several ball bearings.

"Of course, this method can only apply to first grade roads, such as concrete roads, or any other roads in which indentation can be made.

"At the end of the section the rear rodman, having in his possession all of the ball bearings, can go ahead and repeat the procedure as the front rodman . . ."

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FEDERAL SURVEYS IN OKLAHOMA

(Address before the Oklahoma State Section A. S. C. E., March 30, 1935, by N. E. Wolfard, Assoc. Prof. of Civil Engineering, University of Oklahoma, State Representative U. S. Coast and Geodetic Survey, Norman, Oklahoma.)

. . . . . .

I want to ramble all over the world for a time, and then get closer home. I don't know just how much you remember of your college courses in geodetic surveying. . . . .

Geodetic surveying has to do with measurements of the earth, such as shape, dimensions, isostasy, etc. Geodetic surveying was born about 200 years B. C. when a Greek mathematician by name of Eratosthenes computed the circumference of the earth. . . . .

You realize, of course, that in order to coordinate measurements and observations made at different points on the earth's

surface it is necessary to assume a definite mathematical formula on which to compute and project these data. During these years of development in geodesy, several spheroids and ellipsoids have been proposed. The two most generally used are the Bessel Spheroid computed in 1841, and the Clark Spheroid of 1866; the latter being used in America since 1880 and the former more generally used in Europe. In 1909 Mr. John H. Hayford, then Chief of the Division of Geodesy of the U. S. Coast and Geodetic Survey, computed a spheroid using a much larger number of observations than had been available to the previous mathematicians. Only recently Mr. Hayford's spheroid has been adopted as the "International Standard Spheroid". Just how many countries are now computing data to this spheroid I am unable to say. You will understand, of course, that these spheroids are computed to represent very closely the shape or form of the earth at mean sea level.

Returning from my globe-trotting to our own shores, the U. S. Coast and Geodetic Survey was organized in 1807. An engineer and mathematician by the name of Hassler formulated the system which has been consistently expanded very closely to the scheme as originally proposed. As the name implies, our coasts were first surveyed and charted, the transcontinental arc of triangulation being pushed inland as rapidly as appropriations were made available...

Coming now to our subject, federal surveys in Oklahoma, I shall confine my discussion to the work of the U. S. Coast and Geodetic Survey, and cooperative relief agencies. You are aware, of course, that a great deal of valuable work is being carried on by other federal bureaus. . . . .

I have here on the wall a number of maps. This one shows the first-order triangulation network; you will observe that the first arcs approximately bisect the states east and west along the thirty-fifth parallel, and north and south along the ninety-eighth meridian. During the controversy over the Red River and the one-hundredth meridian boundaries triangulation was executed to control this work. Within the last year first-order arcs have been run along the 95° 30", 99th, 101st and 102d meridians. Reconnaissance is now under way for additional first-order and a considerable program of second-order triangulation work within the state.

This map indicates the lines of first and second-order leveling carried on by the Coast Survey at various periods. A considerable amount of second-order leveling has been accomplished within the past two years. There are some ten or twelve level parties at work within the State at the present time. Reconnaissance is also being made looking toward third-order leveling to a grid spacing of approximately seven miles. You thus will realize the scope and completeness of the base net control as originally proposed by the U. S. Coast and Geodetic Survey, and as has been consistently and unfaulteringly prosecuted throughout the past century. You will realize that within the boundaries of our own State, this work is now being prosecuted on a rather extensive scale . . . . . .

You who are members of the American Society of Civil Engineers, have received recently, the reports of our Committee on Surveying and Mapping, Division of City Surveys, published in circular form and entitled, "Technical Procedure for City Surveys". The recommended procedure and accuracy criteria conform very closely to the specifications of the U. S. Coast and Geodetic Survey for the respective orders of surveys. . . . . .

Now, what I wanted to talk to you about for three hours was Local Control Surveys which we have been executing as a relief set-up. I wish to read you the letter that set the ball rolling. (Letter from the U. S. Coast and Geodetic Survey regarding work of local control surveys.)

This letter was received on the morning of November 27,1933.. I wired acceptance about noon. On the evening of the 27th I received a wire advising me of my appointment as State Representative. I wish to direct your attention specifically to the statement in the letter of the first objective, which was "to put men to work". If you recall, this was the watchword of the early days under CWA.

We began immediately to recruit instruments and men, and you would be very much amused to know some of the instruments that were presented by ambitious job seekers. A news article carried the information that engineers with surveying equipment would carry an advantage in early employment. Within the next few days men reported at my office bringing historical models of engineer's and surveyor's transits, levels and three or four terracing levels of very cheap design were offered the service. We had some difficulty in securing instruments in sufficiently good condition to turn out the type of work demanded. The University of Oklahoma furnished the larger portion of transits used on this work. . . .

Our men were organized into parties of ten men each, which provided for carrying on concurrently the angle work, level work and taping. The work was executed under rigid specifications from the moulding and setting of monuments to the chaining operations.

It was a little difficult to get over to these men the fact that all we have to show for our work is a monument net. In the first instance, if monuments are not properly moulded they are short-lived, and of no value. Second, if they be not located where they are safe from future disturbances through construction of land improvements, they are apt to be destroyed and are worthless. Third, if the descriptions of these monuments are not sufficiently clear to enable future recovery by surveyors and engineers, they are of no value even though they be in perfect condition, accurately tied in, by position and elevation; they must be available to future craftsmen to be of any permanent value....

It will be necessary that we endeavor to protect these markers in future construction work. I see my friend Mr. McFerron, of the State Highway Department sitting across the way. I am glad to say that the heads of the several departments of our State highway organization have cooperated to date, and have assured me that they will continue to cooperate in the preservation of these monuments, many of which have been located along main State Highways.

In the earlier days leveling followed railroads, and indeed a large portion of the present leveling is carried on along railroads; however, in most instances, we have chosen to follow highways in our work for two reasons; first, because of better facilitation of executing the traverse; and second, we believe that monuments will be more readily available for future use from highway margins than if set along railroads.

I wish now to describe briefly our routine methods of executing this work. These monuments are first set in pairs with interspacing varying from one-fourth mile to three miles. It is necessary, of course, that these monuments be in pairs in order that future tie-ins may be made.

In some instances we made use of intermediate stations where our route followed winding roads or wooded areas, restricting sight distances, in which instance permanent markers were set in pairs as required by specifications, and our traverses carried across the intervening distances by means of temporary or intermediate stations. Our permanent markers consist of a precast concrete pyramid frustum with 8" by 8" base, 6" by 6" top and 3' high carrying a bronze marker such as is on the table in the rear of the room. At a later date, when elevations shall have been adjusted, the elevations will doubtlessly be stamped on the markers. These monuments were set so that they would project from 2 to 4 inches above the surface of the ground, depending on whether the location was on a hill or in an area where drifting sands and dust might tend to obliterate it. In setting monuments a few shovels of concrete were thrown into the hole and filled around the monument to a height of from 6" to 8" in order to prevent "heaving" by frost action.

Angle measurements conform to second order specifications which means that at any given station the horizon closure must not exceed 6", and preferably should be 4" or less. At each station there are two main angles to measure, or as we term them, "the angle" and "the explement"; "the angle" being turned from the back tangent in a clock-wise direction to the forward tangent, and "the explement", of course, turned from the forward tangent in a clock-wise direction to the back tangent. Each of these angles are measured six times with the telescope direct and six times with the telescope inverted, making twenty-four angles in all, which is termed a set. In every instance two sets are run and if these sets do not agree within the specified limit of 6", additional sets are run until this agreement is obtained. In

order to secure this accuracy you will realize that the transit must be in fairly good order and adjustment, and that a high degree of caution and attention to detail must be exercised by the observer. In working along highways and railroads, stations are staggered, that is, are placed alternately on opposite sides of the right of way in order to eliminate possibility of lateral refraction as far as possible. On sights up to two miles ordinarily hexagonal lining flags are used, such as are exhibited in the far corner of the room. On long sights, or occasionally on days when vision is mediocre, we have used 1" by 4" batting with alternate sections painted black and white or red and white. In order to facilitate quick pointings bright colored flagging is ordinarily attached to the top of pole signals.

Leveling is carried on with ordinary Dumpy or Wye Levels. I should say here that our levels are of third-order and not second-order grade. The criterion of accuracy is 0.05 times the square root of the length of the circuit in miles. In order to secure this accuracy it is necessary that the rods be in good condition. The graduations should be checked with a steel tape and if and when "long rod" is used, extreme caution must be exercised, lest error will creep in. In some instances the rod was read directly by the levelman, in others the target was set and the readings taken by both the rodman and levelman. The latter procedure was ordinarily followed by the less experienced levelman.

Distance measurements are made with ordinary steel tape atop tripods, using dressmaker's pins for chaining pins. I have here the type of tripod used. You will note it is rather simple in construction, yet rigid and serviceable. Tension balances are used and the temperature is read and recorded for every tape length. The tape is compared with the Master Tape for two conditions, that of total support and for end supports only; eleven pound tension is applied under total support and twenty-two pounds with end support only.

Before starting the measurements of a section, intermediate lining flags are set sufficiently often so that two flags will be in sight of the party at all times. Lining of tripod is done "by eye". The complete chaining party consists of at least seven men, preferable eight, comprising head and rear tapemen, head and rear contact men, two tripod carriers, and the chief, who acts as recorder.

Four tripods are used, making it possible to have three tripods always in position so that in case the rear tripod should be disturbed in process of executing the measurement the party could drop back and reset the pin and the work thus far in the section would not be nullified or lost. . . . .

The difference of elevation between successive tripods is

observed, either by hand level or clinometer and recorded. The hand level observer should preferably take his position midway between the tripods on reading, thus errors of the hand level are eliminated or compensated, and also better vision of the staff is had than when he attempts to read the entire length of station.... In order to insure against errors, check taping is necessary. In starting a new taping crew we will check measure with tripod until we have established confidence in our workmen, and the workmen have builded confidence in themselves; then we will measure the line only in forward direction by tripod, check taping with a 300' tape. You will see that if all operations are carried out with precision and care there is no chance of an error greater than 1 in 10,000 occurring in the taping. The only chances for error are in erroneously reading, calling or recording "set-ups", or possible error in losing or adding an entire station.

Regarding night observations, ... you will observe to the left an ordinary automobile headlight ingeniously mounted atop a 1-1/2" gas pipe section. This type of signal was used in several instances. In which case pipe sections of 5' length were used to build a signal 30' above the ground. This is about the limit for which we could anchor conveniently such type of signal. The other type is the standard U. S. Coast and Geodetic Survey transformed automobile headlight signal mounted atop an ordinary instrument tripod. (These lights were set respectively on El Reno East Base station and on one of our traverse stations, while an ordinary mining transit was set over Caddo Triangulation Station and the azimuth thus determined. . . .)

All field records on coming into the office are indexed and filed, and then the routine checking and double checking and approximate closures computed. If these results indicate that the work is correct, all notes are then abstracted and final computations made.

This orange, wearing the dunce cap, has caused some comment and wonderment, so I will endeavor to explain its significance. You all know that a spherical or spheroidal surface cannot be represented on a plane without employment of some form of projection. The particular form of projection in our work is known as the Lambert conformal projection. In the development of this projection a cone is presumed to be placed tangent to the spheroidal surface at two parallels of latitude not too widely distant. You will observe that I have peeled a belt from this orange, which, let us assume, was severed by passing this cone as indicated. Now suppose I take a pin and puncture this peeling at different points, holding the pin parallel to the radii of the spheroid. Indentations will be made on the surface of the cone in the true relationship in regard to direction, however the distance between successive points on the cone and on the surface of the peel will be slightly different everywhere except at the circles of tangency on which they will agree. Within the peel belt the surface distances will be greater than the respective distances on the cone, while just beyond the tangent parallels the cone distance will be greater than

the respective surface distances. Now I will take my knife and sever the cone along an element. You observe that the cone will now lay in or conform to a plane. You observe that the parallels are represented as concentric circles about the apex as a center, while the meridians appear as converging straight lines, conforming to elements of the cone. Without going into mathematics and details of computations you will readily see that a definite relationship exists between the measurements on the orange surface and the projected representation on the cone.

The geodetic positions of all triangulation stations have been computed and are made available by the Coast Survey. Geodetic positions are represented by latitude and longitude, which coordinates are rather cumbersome for use of the surveyor in ordinary field work, hence a system of rectangular coordinates has been adopted, and we are computing the coordinate positions not only of our traverse stations, but also of all triangulation stations in the State. I am calling your attention now to the circulars placed at your plate, entitled,"Plane Coordinate Systems". I am asking that you read carefully these circulars and ponder over their contents, and then decide for yourselves the value and adaptability of rectangular coordinate control. . . . Some of you were present at a recent meeting of the A. A. E. in Oklahoma City, when Mr. J. C. Carpenter, Senior Engineer for the U. S. Bureau of Public Roads, gave us a talk on "Planning", and you will recall, he stressed the desirability of coordinate control in connection with every sort of planning, as well as for the convenience, facilitation and execution of field surveys, investigatings and construction work.

Did time permit, I would like to go into some detail regarding the application of coordinate control in commercial, industrial and social enterprise, and I should not omit military maneuvers. You may feel this last remark a little far-fetched. You may feel that the interior of our great country may never be invaded or may never know the horrors of war, but we should not be too optimistic. At any rate, we can use this control to a great advantage in our civil and economic life, and if we need it for military purposes we will have it.

In closing, I want to leave this thought with you. It is my hope that we may continue directly these control surveys, and that state organizations, both private and public, may add to the expansion of this control nucleus by executing their surveys according to second order specifications, thereby adding materially to the control net. The cost of such procedure would not be greatly in excess of the present methods, and the lasting value of the notes and data thus collected would far exceed the extra cost of execution. Again, granting that the highway department and other organizations should execute surveys which would fit into this control they would not serve their full potential value unless nor until the results should be computed, adjusted to the Clark's

Spheroid and the records made available for reference and usage by practicing engineers. A division of surveys might well be set up in conjunction with our department of highway surveying and mapping where these records, together with the records from the various national surveying agencies, could be collected, cataloged and held available for ready reference.

I hope that we as individuals, and as an organization, may seriously ponder the value of this base control survey to organized industrial, commercial, civic and social enterprise, and lend our efforts toward the establishment of this uniform rigid control for all and every type of surveying.

It is said that speeches as well as operations, should conform to specifications. We are prone to think of the Englishman as slow to take a joke, however, a recent debater from Oxford gave this definition or specification for a speech. He said that it should be patterned somewhat along the lines of a lady's skirt; short enough to hold the interest, but long enough to cover the subject. I leave it to you to judge whether I have met the specifications.

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DISTRIBUTION OF FEDERAL MAPS

Henry J. Sherman,
Consulting Engineer, M. Am. Soc. C.E.

(Reprinted from Civil Engineering for May 1935)

To the Editor: The article on "State Surveying and Mapping Bureaus" by Professor Dodds, in the April issue, is particularly timely in view of the fact that there will be much new material in this field as a result of the greater number of maps now being produced by Federal agencies. These maps will have much wider use than can at present be foreseen and should be procurable through many sources. In the field of air transport alone accurate land charts, based on contour maps, are indispensable. Apart from the need for maps for technical purposes, the public now has increased leisure for such diversions as motoring, hiking and other outdoor activities that necessitate the use of maps. The popular demand for such maps in Europe is enormous, with the result that there are governmental agencies engaged in preparing topographic sheets for use by hiker, hunter, fisherman, camper, and the devotee of winter sports. Distribution agencies advertise their stock so well that almost every motorist and sportsman has his pockets bulging with maps of the territory he proposes to cover.

Under the present administration a new impetus has been given to state and Federal planning, and those engaged in this field know that the basis for such work is accurate topographic maps. Planning entails a knowledge of highways, land classification and use, parks and parkways, water and mineral resources, forests, rivers

and harbors, flood control, ground-water supplies, sanitary investigations, public water supplies, and pipe and power lines. In these and other engineering fields a great deal of time and expense may be saved through the use of standard topographic sheets.

In addition to state bureaus, there should be in each county seat all the data relating to that county so that local engineers can procure them quickly without sending to the state capital, or going there. It should be the duty of the state agency to keep the county offices supplied immediately with all new information.

Furthermore, now that the U. S. Coast and Geodetic Survey is establishing control points in each municipality, the data covering these should be available at municipal headquarters, preferably in the city engineer's office. All surveys should be tied in to these control points, and a copy of the plan should be filed in the city engineer's office.

The present notices of Government maps ready for distribution are sent on cards about 5 by 6 in. in size, and the current information on the subject of maps is printed on these cards in type so small as to necessitate the use of a magnifying glass for comfortable reading. Thus it is obvious that Government methods of map distribution are in need of a radical change. Professor Dodds has made a distinct contribution in the direction of facilitating the distribution of technical map material in this country.

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A WORD TO LIGHTKEEPERS

Requisitions for instruments and supplies received at this Office, as well as the accounts of the various chiefs of party on triangulation, indicate that an unusually large number of batteries and signal lamp bulbs, as well as flashlight batteries and bulbs, are being used by our parties. Much of the expense involved is evidently excessive and can be avoided by a little study and care with regard to the proper use and the method of handling. Our lightkeepers could render a real service to the Bureau, and it is requested that they do so, by studying how adequate light may be furnished to the observer as required at the minimum cost to the government.

In this connection it is well to again repeat the information just passed on by one of our employees who was a lightkeeper a number of years ago, to the effect that batteries will last a long time if the rate at which the energy is taken from them is small; whereas, a battery which is forced to the limit when it is first put in use will render only a few hours of service and be of very

questionable value after that time. Ordinairly, our signal light bulbs require only three batteries in a series to produce the brilliancy necessary to furnish a light to an observer over the lines in most common use today.

When the lightkeeper has communicated with the observing party and placed his lamp in true orientation, he should reduce its brilliancy so that the observer can barely see his light with the unaided eye. This is sufficiently bright for all purposes of observation and generally requires only a few batteries. While the lamps will operate on three batteries connected in series, much better service may be obtained from them by using a set of twelve batteries connected in series parallel. Then, when a powerful light is required, connection may be made to the whole set so as to obtain voltage as furnished from three batteries connected in series, while the energy will come from a reservoir of twelve batteries. This feature of utilizing to the best advantage the energy from dry cell batteries has been well covered in the instructions to lightkeepers. Incidentally, it is the intention that this manual be revised and republished in the very near future, and chiefs of triangulation parties, lightkeepers and others are requested to furnish any information which in their opinion will make it more generally adaptable and useful for the efficient operation of our field parties.

With regard to the use of the bulbs, it is felt that too frequently the lightkeepers strain these to the point of failure merely as a means of saving a few minutes time in locating the observer. This is entirely unnecessary. The majority of our triangulation stations are located on sufficiently commanding points that it is possible for a lightkeeper to see automobile lights or those in houses, towns, etc., at sufficient distances away so that he can quite accurately estimate the amount of light which is required for the observer to locate him. Then he should connect his lamp, increase its brilliance somewhat over what he considers adequate to merely pick up the observing party, and call until he has been definitely identified and communicated with by the observing party.

Care and attention to such details as those outlined above would without question, save the government hundreds of dollars annually for this one item alone.

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USE OF TRIANGULATION STATIONS IN ESTABLISHING AIRPLANE SPEED TRIAL COURSES

For a number of years triangulation stations have been used for controlling topographic maps, for the location of federal, state, and country boundaries and for the control of various engineering operations in cities and the location of private property.

A valuable and rapidly increasing use to which these stations are now being applied is that of determining airplane speed trial courses. Some years ago when the stations were not very well distributed over the counties and states, it was necessary after making numerous computations to execute considerable field work to determine the location of points for the terminals or turning points of the trial courses which must have definite lengths.

With the rapid extension of the triangulation net under the program of providing control so that no point in the United States will be more than 25 miles from a triangulation station, so many stations have been established that in most cases very little if any additional field work is necessary for the determination of the terminals or turning points of the trial courses.

Recently a request was received by the Bureau from the National Aeronautic Association for assistance in the determination of a triangular racing course of 1000 kilometers between New York, N.Y., Washington, D.C., and Norfolk, Va. The Coast and Geodetic Survey has established a number of triangulation stations in the vicinity of each of these cities, so that after several inverse computations were made, three stations were found which fulfilled almost exactly the requirements for the 1000 kilometer course. The stations selected were Bennett in Floyd Bennett Field, New York; Insane Asylum near Bolling Field, Washington; and Willoughby Beacon near Langley Field, Norfolk. The lengths of the three legs of the course are given below.

		kilometers	miles
New York -	Washington	328.343	204.02
Washington -	Norfolk	218.731	135.91
Norfolk -	New York	453.189	281.60
	Total	1,000.263	621.53

In the tests made over this trial course the theodolite checking method was used for the first time. At each of the turning point stations, a theodolite was set up and as the pilot approached each point he established radio contact with the pylon observers, and the plane was then picked up by the theodolite and followed during the course of its turn.

Since it was impossible to place theodolites at our triangulation stations on the Insane Asylum and on Willoughby beacon, it was necessary to determine new stations to serve as turning points at short distances from these two stations.

A few months ago the Bureau was requested to assist in establishing in the vicinity of New York, an airplane speed trial course which consisted of six legs for a total distance of 500 kilometers. We were able to use six of our triangulation stations as turning points and the length determined by them was 500.02 kilometers.

There have also been a number of requests for trial courses with lengths of 50 kilometers. In all cases triangulation stations had been established in the vicinity of the turning points and very little field work was necessary to determine the courses.

Since the demand for commercial airplanes is rapidly growing, there will be increased need for speed trial courses, and consequently greater use for our triangulation stations.

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USE OF RAILROAD FILLS AS WINDBREAKS FOR LEVELING PARTIES

Charles M. Thomas

With our twelve leveling parties, comprising about seventy-six leveling units, most all the new "wrinkles" that tend to improve the accuracy and expedite the progress of their work have very probably been tried out by now. However, to some of the observers on our leveling parties who have not already tried it, the following method, used occasionally by me in the windy Dakotas, should prove helpful.

When the wind began to blow exceptionally hard, so that the rodmen could hardly keep their rods on top of the T.P. spikes, and the umbrella boy was having a time trying to keep the sudden gusts from causing him to bump the level and also trying hard to remain master of his "charge", it was then that I dropped down into the leeward ditch for my setups. In this section of the country, similar to many of our other flat states, most of the railroad beds are built up a few feet above the bottom of the wide ditches on each side from which the required amount of material was excavated for making the fills. Setups were made in the leeward ditch and near the foot of the low fill, or on the side of the fill where it was too high for both rods to be read from a setup in the ditch as the rodmen were continuing to use the track spikes for turning points. By this method the entire tripod was shielding from the wind, and the exposed level escaped most of the wind, which was deflected over the top of the level due to the slope of the fill on the windward side. After a little practice, quick setups can be made on the side of a fill with practically very little delay. (While speaking of hillsides, no attempt will be made to settle the old argument as to which is the best and quickest setup, with one tripod leg downhill or two. The former has always been preferable to me, but there are arguments on both sides. However, from an instrument's point of view there is no doubt as to which shoulder it should be carried on, and that is the downhill shoulder of the carrier when he is walking along a hillside. In case the carrier's feet should suddenly slip out from under him, the instrument would have a soft landing spot on the carrier. Had it been on his upper shoulder, the instrument would have hit the ground first with the carrier landing on top of it, which would be quite a lowly and unbecoming predicament for a delicate and sensitive instrument to find itself.)

By using the foregoing method when the wind is too strong for the observer to setup between the rails, very accurate levels can be run in spite of the wind, provided it is not blowing parallel to the track. However, this method has its advantages in this case too, as the readings near the bottom of the rods are practically free from small errors due to the rods slightly vibrating in the wind, these errors being in proportion to the height of the rod readings.

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THE USE OF GEODETIC CONTROL FOR CADASTRAL SURVEYS

The May number of the Geodetic Letter was devoted wholly to a symposium on the use of geodetic control for private boundary surveys. In it was included a form of bill proposed to meet survey conditions in the State of Florida. This bill, with explanatory comments on its various provisions, was distributed for study and comment to members of the Florida Mapping Authority by H. A. Elmore, Executive Engineer of Local Surveys in that State.

From Mr. Elmore there has been received a splendid digest of points raised and comments made. This paper is a most valuable contribution to the subject, and though in parts it may deal with survey conditions peculiar to Florida, it should be very helpful to students of this subject in other states and it is hoped that it can be published in its entirety within the next few months. For the present it has been deemed proper and useful to select for immediate publication a few paragraphs which have fundamental and general application. These are given below. - Editor.

"If a land tract should in future be conveyed for the first time by coordinate description alone, the county officials and others would have no means of knowing the relationship between the new description by coordinates and the old description by land divisions."

An index map showing (1) the township lines and the boundaries of grants and other areas not conforming with the U. S. Land Survey, and (2) lines showing latitudes and longitudes in degrees and minutes, would serve as a general index to the descriptions of titles under the old and the new systems and for tracts not subdivided into numbered lots would probably be sufficient to locate any such descriptions close enough to serve for both systems, whatever the old system for that tract may have been. Plots of subdivisions into numbered lots are usually indexed in a separate section of the index book or in a separate book, with cross references to the alphabetical index of plots and the index by township and range. The addition of a line or column with cross reference to degree and minute of latitude and of longitude would add but little to the volume of the index. The index map referred to would aid in the general location.

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"To locate the tract described would require a knowledge of the coordinates of some established land corner near by. If these were not known, and most of them would not be known at first, either the conveyor or the county would have to establish them."

Neither the establishment of the survey monuments nor the statement of the plane coordinates of those monuments assumes to locate land survey corners or to determine the accuracy of their location by others. A survey monument is a convenience for a property owner in locating, exactly, a point or points on the boundary lines of the property concerned, with such connections and references as will enable him to replace a corner of the property or even a plane coordinate survey monument, should it be lost or destroyed.

Many original section corner marks in Florida can still be found, but if used as evidence in a case in court their validity is subject to attacks. Corners which have been replaced, using the rules of the U. S. Land Office in recovering them, are subject to attack and require more definite proof. And any stake or pin which has been assumed to be a section corner must meet the charge that its location is a matter of hearsay. To these attacks on the validity of a corner must be added the statute provision that a general acceptance for a fixed number of years of a property corner or a property line, if properly proven makes it legal in the absence of proof to the contrary acceptable to the Court. It is evident that the connection of a given stake or monument with a plane coordinate survey monument cannot fix the validity of that stake as a property line marker. In other words, the plane coordinate survey monuments are a convenience and a safeguard to property owners connecting with them and do not in any way displace the original U. S. Land Survey markers or guarantee the accuracy of points or markers claimed to be such markers or the valid substitutes for them. This last question is a question of property rights, for the decision of which there is at present no resort except the common courts of law. The property owner, or in case of dispute between adjoining property owners, the court is the only authority by whom the location of a property corner or property line can be settled. The question arising in suits for trespass or to determine contesting claims to real property are so often technical and not clear to the usual judge or attorney that the establishment of a special land court or courts would improve the value of court decisions on property boundaries and relieve the local courts of many time-consuming cases.

The system of plane coordinate monuments will reduce the number of land boundary cases in court or to be settled out of court as rapidly as the number of connections of property corners with the monuments of the plane coordinate system increases. This is especially true if, when such connections are made, all persons interested in that connection agree upon the validity of the corner or corners to be connected.

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"I do not believe the average land surveyor will get much out of the Mercator and Lambert projections used as the basis for rectangular plane coordinates in districts in Florida."

In practical surveying of land, the system of rectangular plane coordinates in the district in which the tract surveyed is located is all the surveyor is directly interested in. He need know nothing of the theories on which the computations of the rectangular plane coordinates are based so long as the area to be located is in one district. The general statements regarding the maximum deviations of the rectangular plane coordinates from the geographical coordinates of the same points give maximum differences within the limits of error in making good land surveys and in many cases within the limits of error of second order traverses. They may have such accuracy as is required for detailed surveying of large cities and of individual properties located therein.

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"I believe that the system of rectangular plane coordinates will prove very useful. I doubt the wisdom of passing any legislation at the present time requiring engineers to tie their surveys to these monuments as I do not think sufficient monuments have been set so far. When we get enough monuments in Florida so that coordinates of every section corner are shown, it will then be time to urge such legislation."

None of the forms of statute proposed thus far have compulsory provisions. Lack of monuments, the comparatively small proportion of the state in which any reasonably large number of monuments have been set, and the far-reaching effect of any compulsory features, have been the principal reasons for the restriction of the proposed provisions to purely voluntary action on the part of property owners, engineers and surveyors, in taking advantage of the provisions of the statute.

The declaration by the statute of the legality of the system authorizes its use and gives opportunity through such use for demonstrating its convenience, its efficiency in reducing the number of difficulties in coordinating surveys and improving their accuracy, and in facilitating preparation of deeds which will make it possible to locate such property on the ground exactly. It facilitates all the operations connected with the transfer of titles and the location of the ground whose title is conveyed. The principal sources of delay in putting the system into immediate use are the lack of monuments and the lack of familiarity with the advantages of the system.

Practically it would be impossible to make compliance with such a system compulsory at present. Theoretically, compulsory provisions are contrary to the present legal practices in reference to property transfers and probably they will not be considered advisable until familiarity with the system with experience in its voluntary use have shown its advantage to the public to such an extent

that they demand compulsory extention of its benefits to all real property.

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These monuments and the accuracy of their locations fill the gaps in the U. S. Land Survey permanently and should relieve the properties within the areas of those surveys of the numerous attacks upon the accuracy of their locations and sometimes of their descriptions. When connections have been made to the monuments of the rectangular plane coordinate systems, the locations within the U. S. Land Survey areas will be made permanent and sure.

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NEWS NOTES FROM HOME AND ABROAD

A publication issued by the Corps of Engineers of the War Department, entitled, "Triangulation Along the Mississippi River, Cairo to Barfield to Memphis", has been received by the U. S. Coast and Geodetic Survey.

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"A Working Outline of Engineering Astronomy" by Dr. Jerry H. Service, has just been received by this office.

Dr. Service is now Associate Professor of Mathematics and Physics at the Michigan College of Mining and Technology, Houghton, Michigan. From 1923 to 1928, he was a commissioned officer of the U. S. Coast and Geodetic Survey during which time he was co-author with Captain N. H. Heck in a Special Publication of the Bureau entitled, "Velocity of Sound in Sea Water".

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A recent letter from Professor Robert L. Sumwalt, Professor of Civil Engineering, University of South Carolina, Columbia, S. C., addressed to the Chief, Division of Geodesy, contained the following paragraphs regarding his visit to one of our base line parties:

"Recently Mr. H. E. Breen, Chief of Party, U. S. Coast and Geodetic Survey, invited me to bring my students to visit his base line party which was operating approximately 5 miles from Columbia.

"It was my pleasure to accept his invitation and to take thirty students, together with Professor E. R. Cary, Professor of Civil Engineering, Rensselaer Polytechnic Institute, who is now spending the winter in Columbia. Mr. Breen explained his work in detail and gave us a splendid demonstration of base line measurement. We followed the party along as they measured the line and noted with much interest the precision which was exercised in the work."

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A copy of Leaflet 77-June, 1935, issued by the Astronomical Society of the Pacific, entitled, "Astronomical Work of the United States Coast and Geodetic Survey", by William Bowie, Chief of the Division of Geodesy, has been received by the Library of the Coast Survey.

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The following letter from the National Aeronautic Association has been received by the Director:-

"Please accept our sincere thanks for the very excellent services of the U. S. Coast and Geodetic Survey in connection with the establishment of the 1,000 kilometer speed course between New York, Washington and Norfolk, Va., recently established for the world record speed trials of D. W. Tomlinson.

"We are pleased to say that Commander Tomlinson established nineteen records over this course during his recent flight, eight of which were international performances.

"We also appreciate very much your cooperation in entrusting Lieutenant R. L. Pfau of your New York office to assist in the establishment of an official 100-kilometer course from the Newark Airport to Long Branch, N. J. Major E. E. Aldrin, we are glad to say, established a new world 100-kilometer amphibian record over this course on May 16."

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Colonel Mo Tsao, Chief of the Division of Geodesy in China, was a visitor of our Bureau for several months this spring. He made an intensive study of the methods employed in the Division of Geodesy, and while in the office, divided his time between the different sections, working awhile in each and making computations, notes, and gathering all information that would prove of benefit to his colleagues in China. Colonel Mo Tsao was also greatly interested in the section of aerial photography as he hopes to employ this same method of surveying in China where it should prove very beneficial in the mapping of such an extensive country.

A program was laid out for Colonel Tsao to visit some of the geodetic parties in the field engaged in various classes of our work. During this time of the year, early spring, all the east coast parties were working in the southern states. It was possible for Colonel Tsao to visit these parties with a minimum amount of travel. In the State of Georgia, visits were made to the reconnaissance party of Mr. T. J. Mitchell, the steel tower triangulation party of Lieut. John Bowie, Jr., and the leveling party of Ensign William R. Tucker. Colonel Tsao then proceeded to Florida where he visited the astronomical party of Mr. Charles A. Whitten and the base measuring party of Mr. H. Edward Breen.

The visits to these parties proved of great interest to Colonel Tsao as he was able to assemble much information concerning the methods and organization of our parties in the field and he felt certain that his geodetic parties in China would greatly profit by his experiences.

Colonel Mo Tsao made many friends while in this country and his visit was enjoyed by all those with whom he came in contact.

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An article entitled, "Support Given to Geodesy by the Government of the United States of North America", by William Bowie, Chief of the Division of Geodesy, appeared in the January 28, 1935, number of the Comptes Rendus of the Academy of Sciences of Paris, France, a copy of which journal is on file in the Library of the Coast Survey.

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In a letter received by the Chief of the Division of Geodesy from Professor Alan F. C. Pollard of the Imperial College of Science and Technology of London, is the following paragraph:

"I particularly wish to thank you for the copy of your informal journal. It is most interesting and if quite convenient to you I think the Science Library here should receive it regularly. I too, would like to receive it regularly, but if there is any difficulty in mailing copies to the Science Museum and to myself, it would be more important for the former to receive it."

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The April 1935 issue of DE INGENIEUR IN NEDERLANDSCH-INDIË contained an article by J. H. Meursinge, Civil Engineer, Huntington Park, California, entitled, "The Bilby Tower for Triangulation Measurement". This article carried three illustrations; one of a Bilby steel tower completed, another in process of erection and a picture of a Parkhurst 9-inch theodolite.

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In an address to the National Committee of Geodesy and Geophysics held at the Royal Academy of Sciences in Brussels, Belgium, General Seligmann discussed the copies of the Geodetic Letter which he had received.

General Henri Seligmann is President of the National Committee of Geodesy and Geophysics; Secretary of the Belgian National Research Council; Chairman of various Committees in the Association of Geodesy; formerly Director of the Military Cartographic Institute at Brussels, retiring from active service in 1928. He was formerly a member of the executive committee of the Association of Geodesy

and was Acting President of the Lisbon General Assembly in 1933.

After a detailed discussion of the different topics given in each issue of this informal journal, he said:-

"In reality, there is a bit of everything in these Geodetic Letters and this publication accomplishes its principal aim which is to instruct the field personnel, to keep it interested, to acquaint it with what others are doing, to help it in its work and also to derive from the work all information possible.

"Besides all this, there are, at the same time, questions and information which are of general interest and which may be of use to geodesists of all countries.

"Finally, in following the reading of this publication, one is kept up-to-date almost from day to day with the progress of the work and the innovations as well as with all events, and this to a much greater extent than one is able to learn from the general reports which appear only annually and naturally are a little behind the times . . . . .

"These Letters are addressed to the whole personnel from the most humble to the chief of party, and it is especially in this that they are useful. Considered from the practical point of view, most important or most essential, is the advice, remarks on the instruments, on their use and on the special cases which present themselves. The questions raised by the field men which are not taken care of by the instructions, even though very complete, and which are answered in the Letters, are questions which will benefit all field personnel not only the personnel of the Coast and Geodetic Survey, but also that of all other countries which are carrying on triangulation and level work. The bulletin "Geodetic Letter" is collecting a mass of information which may be of service to all."

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It is requested that members of our field parties exercise extreme caution in seeing that no debris of any kind is left to remind property owners unpleasantly of their visits. The following card has recently been received at this Office:-

"Please instruct your field men to leave no boards full of nails upturned in pastures where they may injure the work horses or cattle. This has been done in my pasture where the field men tore down and rebuilt wigwam or signal posts."

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REPORT OF PROGRESS

Triangulation:

Lineal miles of triangulation through axis of schemes completed during April, 1935:

First-order - - - - - - - - - - - - - -	1,065
Second-order - - - - - - - - - - - - - -	899

Completed during May, 1935:

First-order - - - - - - - - - - - - - -	1,121
Second-order - - - - - - - - - - - - - -	253

Total miles of triangulation completed to May 31, 1935:

First-order - - - - - - - - - - - - - -	60,032
Second-order - - - - - - - - - - - - - -	5,116

Levels:

Lineal miles of levels completed in April, 1935:

First-order - - - - - - - - - - - - - -	933
Second-order - - - - - - - - - - - - - -	9,030

Lineal miles of levels completed in May, 1935:

First-order - - - - - - - - - - - - - -	811
Second-order - - - - - - - - - - - - - -	9,057

Total miles of levels completed to May 31, 1935:

First-order - - - - - - - - - - - - - -	105,115
Second-order - - - - - - - - - - - - - -	140,526