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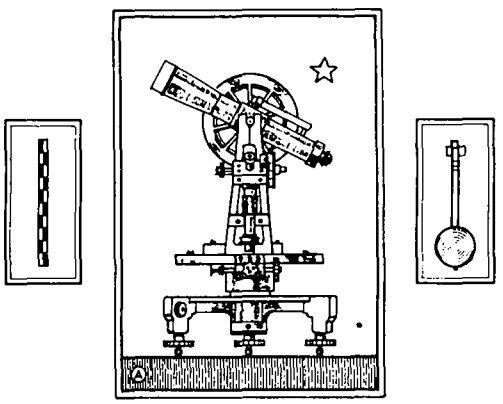

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G E O D E T I C L E T T E R

November, 1935

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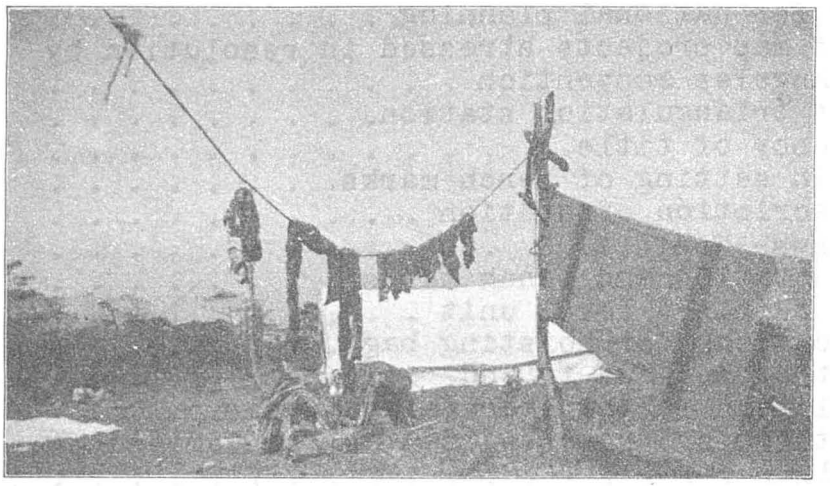
G E O D E T I C L E T T E R

November 1935

VARIETY OF DIET



Strips of fresh mule meat drying in the sun. Owing to a serious shortage of food experienced at one time by J. P. Lushene, observer on the Guatemala-Honduras Boundary assignment, it was necessary to slaughter one of the pack animals.

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SAFEGUARDING SURVEY MARKS IN CALIFORNIA

The State Highway Engineer, State of California, has notified his district engineers that all maintenance crews should be informed of the value of bench marks established by the United States Coast and Geodetic Survey and other federal bureaus, and that steps should be taken to prevent their disturbance. The following is quoted from his instructions:

> "It is desired that the value of these marks be brought to the attention of all maintenance employees, and it is suggested that, where such action seems advisable, a 3 inch by 8 inch marker post be installed near (not closer than 18 inches) each bench mark or other permanent survey

mark set by Government crews in order that their location will be evident to the men handling equipment, and that instructions be given that under no circumstances are such marks to be disturbed."

If this procedure were followed by all state highway engineers, they would render a very valuable service to the engineering profession.

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MAPPING FOR NATIONAL PLANNING

(The two articles which follow are reprinted from "Civil Engineering" for August, 1935.)

In order to emphasize the value of present and proposed mapping activities throughout the country, a pamphlet entitled, "Mapping for National Planning" has recently been issued by the Society. This 58-page publication, based on a program presented before the Surveying and Mapping Division of the Society last January, at which time a paper by Frederick H. McDonald, M. Am. Soc. C.E., was read and discussed, dwells upon the important relations of mapping to other national projects. It presents a forceful argument for the beneficial use of mapping in developing national and community planning, in utilizing natural resources, and in everyday commercial progress. In addition, the helpful effects on employment in engineering and planning work are emphasized.

How important this phase of employment may become will be evident to any engineer who can see the possibilities of putting to work untrained men in minor positions, such as rodmen, recorders, and chainmen. Already the government has had unusual success in this type of work, as reported by William Bowie, M. Am. Soc. C.E., chairman of the Surveying and Mapping Division, which has sponsored this report. In his own department of the Coast Survey Major Bowie has employed, in addition to his regular staff as many as 350 engineers with degrees and over 400 who are graduates in some other field or who have taken college work. In fact, more than half of the 1,560 emergency men employed were engineers or college men. There is also a large group in the U. S. Geological Survey, which has likewise provided a great deal of worth while emergency employment. Because such a large proportion of the work requires the employment of white collar personnel it is apparent that this field presents an unusual opportunity. The pamphlet discusses the possibility of such work and the extent of the planning and mapping that may reasonably be undertaken.

While the pamphlet is intended primarily for the use of governmental officials - federal, state, county, and municipal - it will also make interesting reading for business and professional men. The edition is limited and not for general distribution, but a number of copies have been set aside for the use of those members who may especially desire to study this important topic. Requests for complimentary copies will be filled at Headquarters as long as the supply lasts.

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VALUE OF MAP PROJECTS STRESSED IN RESOLUTION BY LOS ANGELES CONVENTION

Whereas, effective planning for the conservation and development of the nation's resources must be based on fundamental data secured through physical surveys and recorded on maps; and

Whereas, at the present time there is, unemployed, the necessary technical personnel to gather and record such data; therefore,

Be it resolved by the American Society of Civil Engineers in Convention assembled at Los Angeles, California, July 3, 1935, that those organizations of the Federal Government charged with the allotment of funds, appropriated under the Emergency Relief Appropriation Act of 1935, be requested to support liberally in a financial way the Federal, State, and Local Agencies (including planning commissions) concerned with the gathering, assembling, and correlation of all data relating to topographic and geodetic surveys and maps; and

Be it further resolved and recommended that the requests for funds which have been presented by the U. S. Geological Survey and the U. S. Coast and Geodetic Survey be approved and prompt allotments made, and;

Be it further resolved, that the purpose of this resolution be urgently presented to the proper Federal authorities.

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NAMES OF TRIANGULATION STATIONS

G. C. Mattison

The June issue of the Geodetic Letter contains an article regarding the naming of triangulation stations, and mentioned the possibilities of title disputes in case the stations are named after the owners of the property. Most of our triangulation surveys have been over valuable land, and we have noted several incidents, which combined with the possibilities mentioned in the Geodetic Letter, would indicate that it is inadvisable to name a station after

the land owner or tenant.

Case # 1. A station was established on a rock ledge in back of a home after first obtaining permission from the house owner who stated the property included the ledge. Her name was stamped on the marks. A few days later, the observing party had a difficult time of it when another claimant to the rock ledge put in an appearance and objected to the name on the disks. The lady was highly elated that the Government had marked the property as hers, as she said there always had been a dispute regarding the boundary. Needless to say, the name of the station was changed.

Case # 2. A recovered station, named after the owner (1875) was remarked. The present owner objected strenuously to having the name of the former owner stamped on the disks, and it was necessary to explain the reason why the former name should be retained. The explanation was accepted without enthusiasm.

Case # 3. Special incidents have occurred where it was necessary to place azimuth marks, and occasionally reference marks on adjoining property. Invariably there is objection to having the neighbor's name stamped on them.

It is very evident that property owners consider the marking of these stations as of considerable importance. Connecticut property and property rights at the present date, represent to us a picture of future conditions in other localities. Our experience has been such that we now deem it advisable to name a station with a non-controversial name.

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SUFFICIENCY OF TITLE

N. E. Wolfard

Conveyance of real property is, or should be, conditioned on clear title which is attested by abstract. Abstract is a summary of records financial, legal and descriptive. Descriptive record is established by position, fixed or relative.

Today we are much concerned with reestablishment of boundary lines and reference points. The relative position of two or more reference points controlling the boundaries of adjacent properties not infrequently causes enmity, strife, or oral combat between neighbors. A venerable old pioneer engineer and surveyor remarked to me not so long ago that he had made his last land survey. He said that a survey which he had made some twenty years before occasioned fatal altercation between the contesting parties. I dare say, the reader can recall similar cases in his own experience, possibly not so extremely tragic.

It is somewhat difficult for some property holders to understand why a surveyor with his compass or transit cannot readily reestablish with exactness old boundaries from deed description. Equally puzzling to them is the fact that two competent surveyors may not establish a given boundary in the same position. To understand the former difficulty it is only necessary to investigate the equipment and methods used in establishing early boundaries. The latter condition frequently arises from the fact that descriptions of adjacent tracts are often tied to different reference points, the record relative position of which is in error. Consequently there may be an overlapping of boundary or else a "devil's lane" or "no man's land" between nominally abutting properties.

In these days of intensive commercialism and consequent soaring property values pioneering methods of survey and monumenting are no longer adequate. Exact position, horizontal and vertical, is desirable and often essential. There is but one way to secure exact position ---- that is to "tie your property to a star". Were the earth a perfect sphere astronomic observation at any point would give at once the exact and relative position of the observer as referred to other points so determined.

Geodetic control of position on the earth's surface, however, is not so simple. The spheroidal form of the earth necessitates certain adjustment of observed position by latitude and longitude to establish truly relative positions. It is also necessary for the purpose of mapping and charting to reduce all distances to arcs of a common surface of equal elevation. Mean sea level has been chosen by the U. S. Coast and Geodetic Survey for this common surface, as well as datum for vertical control.

A certain definite spheroid which fits the North American continent very closely was computed by A. R. Clarke, an eminent British geodesist, about the middle of the nineteenth century. A single point of reference, referred to this spheroid, located in west central Kansas, has been adopted by the United States, Canada, and Mexico as initial control for position and mapping. This point, called Meade's Ranch, is known as North American datum.

Triangulation arcs girt most of our coast line and articulate with transcontinental arcs. Position and azimuth of the stations are computed with reference to the above datum in high degree of precision. It is contemplated that these precision, or "first-order" arcs, shall eventually form about a fifty mile mesh grid over the entire nation. By way of information "first-order" surveying implies angular closure of triangles or of the horizon with a maximum error of 3 seconds, while the average error will be 1 second or less; linear closure shall be 1 in 25,000 or better. "Second-order" work implies angular closure of 3 seconds to 6 seconds and linear closure of 1 in 10,000. "Third-order" work calls for angular closure of 6 seconds to 10 seconds and linear closure of 1 in 5,000. "Fourth-order" work comprises stadia surveys and filling in of map details.

The rigid control scheme proposed by the U. S. Coast and Geodetic Survey early in the nineteenth century has been slowly but consistently expanded. The precise triangulation arc grid mentioned above constitutes the basic control scheme. This grid is to be supplemented with "second-order" triangulation and traverse which, in turn, will be expanded by "third-order" traverse, furnishing control for detail mapping. Now we are, nominally at least, back to the point where we started; that of position. However, the reader will agree, I am sure, that a point of reference determined or established by the rigorous procedure of Coast Survey methods will be more exact in position, more permanent, and more readily reestablished in case it becomes disturbed, than is the ordinary point of reference used in deed description.

The surveys set up as C.W.A. projects throughout the several states in December, were mostly concerned with "second-order" traverse and leveling. The general procedure was to execute traverse from previously established and computed arc triangulation stations. The traverse was to be run from one station to another along highway or railway and monuments carrying a standard bronze marker set from one-fourth mile to two miles apart, depending on topography and cultural demands. Thus were formed closed loops affording accuracy check. Levels were run along the traverse establishing elevation of each marker, together with intermediate bench marks on bridge heads, etc. These monuments afford convenient and accurate horizontal and vertical control reference points for future surveys and "check in" points for surveys already made.

A system of coordinates has been set up for Oklahoma and computers are now busy computing the coordinates of all triangulation stations within the state as well as the coordinates of each of the monuments set in the local control survey now in progress under C.W.A. The advantage of a state coordinate system of reference points is evident on a moment's reflection. With public and private surveys throughout the state referred to common position coordinates and elevation datum, relative position, either vertical or horizontal, of control or objective points in a projected enterprise, great or small, could be readily determined without preliminary surveys.

In order to facilitate the usefulness of data resulting from the numerous surveys constantly being carried on by various governmental units, corporations, and individuals, a clearing house in the form of a state survey bureau should be set up. The functions of this bureau would be various and far-reaching, and must needs be a subject of separate discussion in a future issue. Modification of procedure in legal surveys and public responsibility and license of surveyors should come up for study and analysis.

It is hoped that engineers and surveyors, as well as industrial and political leaders, will consider and analyze the coordinate basis for surveys in its various aspects of economy, utility, accuracy, and permanence.

CHANGE IN SETTING OF BENCH MARKS

From time to time there has been considerable discussion regarding the change in elevation of bench marks caused by frost action. It is very rare that, except in marshy land or where there is quicksand, any question has been raised with regard to the settling or rising of monuments from any other action but that of freezing, thawing and earthquakes.

However, the following is quoted from a letter received from Mr. William Mussetter, under date of July 15, 1935, concerning disturbance to station marks in certain black soil which shrinks and cracks open during dry weather and consequently goes through the opposite process during wet weather:

> "Some time ago I remarked that station marks in Texas black lands should be especially deep, and you asked for the reasons. The explanation is that this land has a peculiarity of shrinking and cracking open during the hot dry summers. The cracks are often large enough to lose a fence rail in, and probably go 10 feet or more deep. They partially fill with dust and debris, and when rain falls, the soil expands and has a tendency to heave and creep, similar to frost action. Some of the 98th Meridian marks were so disturbed, one reference mark I remember, having been forced about half way out of the ground. My attention was called to this in 1930 by some State engineers who reported that several of our bench marks between Vanderbilt and Kingsland had been disturbed. Apparently, a deep, well-rooted mark resists the action. The 98th Meridian marks were unsuited, as they had a wide rim at the surface, with minimum diameter at the bottom. Some old Hydrographic and Topographic marks found were about the size and shape of a boarding house wash bowl. Without exception, they had been disturbed. This action does not occur in sandy, gravelly soil, or the red clay of East Texas. It seems to be less in cultivated or wooded lands than in bare pasture, although the reference mark mentioned was in a mesquite thicket,(station Kaleta)."

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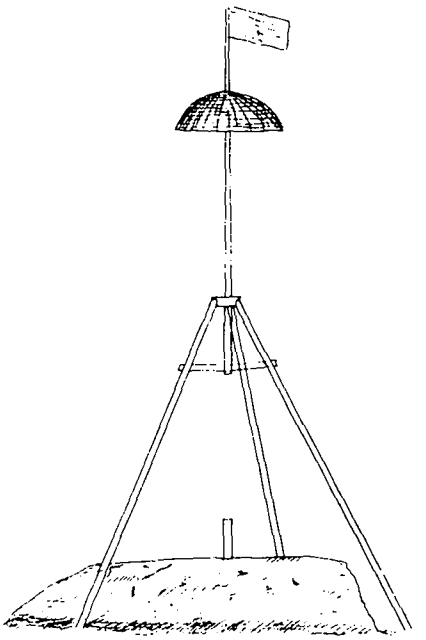
1876 DESCRIPTION OF STATION

The following description of a triangulation station was found recently in the Coast and Geodetic Survey records. It is not offered as model description but as a sidelight showing how a humerorous moment influenced this one.

"New Lump (Plaqueimines Parish, La., H. L. Marindin, 1876). -- On a convulsion of nature, toward the point (from that great triumph of the 19th century of art over nature known as the West Jetty) where the great luminary retires after completing his fiery course through the etheral arches, stands a structure designed to assist in the scientific researches of the Coast Survey. To preserve it to fame and the future a hollow iron cylinder will be forced into the bosom of Nature by repeated blows from a lusty Celt. Extensive ravages by old Ocean have reduced the size and glory of this little isle and now it rears its head only about 2 feet above the fullness of the waters. To an observer gazing N. 3/4 W. will appear Kipp; while if he turns his vision NE. by N. 1/2 N. Parmelee will meet his averted eye. Gentle reader, contemplate a sketch of the subject."



New Lump

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PATHE NEWS--TOPIC NO. 1

A 3-minute sound reel titled "The Invisible Roadways to the Sea", prepared by Pathe News with the cooperation of Lieut. Comdr. George D. Cowie of this Service, known as Topic No. 1, will be released throughout the country this month. An accompanying talk described an observing party on one of Lieut. (j.g.) McCarthy's triangulation towers in the Navesink Highlands; a topographic party working along the beach (with a closeup of a plane table sheet); a launch hydrographic party of Lieut. I. E. Rittenburg; a view of the Surveyor in Alaska (copied from a film loaned by this office to Thomas Chalmers, Editor of Pathe News); and a composite animated section showing the operation of echo sounding, i.e., the sound travel by means of dashed lines from the oscillator to the ocean bed and thence to the hydrophone, with a closeup of a fathometer and the flashes of its dial.

A copy of this film was furnished the Bureau and a preview showing, attended by all interested members of the Washington office, was held in the Commerce Building auditorium on the afternoon of October 29, through the courtesy of the Chief Clerk of the Department.

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PLACING STATION AND BENCH MARKS

A recent letter from Mr. Harold N. Carey, formerly of the Coast and Geodetic Survey but now employed by the South Dakota State Highway Commission, offers a valuable suggestion for the placing of future station marks and bench marks. Extracts from the letter are given below:-

"Since the Coast Survey work closed down in August, I have been working with the South Dakota State Highway Commission.

"The Commission seems to have standardized on 100-foot rights of way for state highways. That means, when a road is regraded, on a stretch where there is not a great deal of cut or fill, that the ditches are cut back to a point 48 feet from the center line.

"I would suggest then, that on reconnaissance for triangulation, or for levels, the points selected for marks be kept at least 50 feet back from the center lines of main roads. It would also be a good idea to keep them away from intersections of main roads, for one can never tell how much right of way may be used at the intersections. Quite often there may be curves put in to cut off the sharp corners, and these vary as to the amount of land taken in.

"The above would apply to the main county highways as well as to the state highways."

Other states will undoubtedly adopt similar standards of width for new construction and chiefs of party should bear this in mind when instructing their mark setters so that our stations may survive.

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SIX-MAN COMBINED LEVEL UNIT

W. W. Studdert

I cannot be too enthusiastic over the operation of the six-man combined level unit, with the sixth man setting bench marks for the unit. Having worked with both methods, the other method being where the bench mark setter is in another truck, operating many miles and weeks ahead, I find that greater cooperation, economy and speed can be had where all functions are close together in a compact group.

The bench mark setter, when operating in the same truck as the level party, should at all times keep one full day's work ahead of the level party. This can always be done with ease.

On second-order levels along railroads, this means that the bench mark setter should be about 10 miles in advance with his work. As this 10 miles has to be travelled in excess of the observing party, it means that the bench mark setter will travel 20 miles farther in the truck each day than the level party. Therefore, his hours of actual work will be only 40 minutes less than the level party.

On arriving at the scene of work in the morning, the observer in charge of the unit instructs the bench mark setter to contact the level party at a certain point at a certain hour, usually 4:00 P.M. At 3:30 P.M. the bench mark setter starts back along the line and picks up the observing party. An hour's trip is about the maximum ride that the units are allowed to work away from camp. Excess speed is not allowed as our trucks are old, and in mountainous country, high speeds might prove disastrous.

The truck's mileage on second-order levels along railroad tracks, for a unit of six men in a combined party, working 25 miles from camp would be:

With complete party out.	25.0 miles.
Full day's work previously bench marked.	10.0 "
Day's work to be bench marked.	10.0 "
Total trip out.	45.0 miles.
Total trip in.	45.0 "
Total distance for truck with work now 35 miles from camp.	90.0 miles.

If this same day's work were done by separate bench mark and observing units, the truck mileage would be:

Observing party.

Trip out with all members of observing party.	25.0 miles.
Truck moved ahead to pick up observing party.	10.0 "
Return trip to camp.	35.0 "
Total for observing party truck.	70.0 miles.

Bench mark party.

Morning trip out and day's work.	45.0 miles.
Return to camp.	45.0 "
Total for bench mark party truck.	90.0 miles.

The above figures show that only 20 extra miles of truck travel were used by the combined party over a straight observing party, whereas 70 miles of truck travel were saved by the combined party over the separate bench mark and observing party. Another feature that must be considered is that a 5-man observing party is at a disadvantage in moving ahead their truck when running second-order levels.

From the viewpoint of a bench mark setter, I have found that they would prefer a truck of their own in order that they might be more free of supervision. I know from actual bench mark setting experience that they have plenty of time in six hours to set eight bench marks of varied types, therefore, it is not time that they need.

From an observer's viewpoint, I find that the extra convenience of having a man along who already knows the roads is of great aid in promptly reaching the scene of work. The additional responsibility of bench mark supervision and coordination of the work sobers most young observers. Not being hindered in his actual leveling by having to send one of his men ahead for the truck is of assistance, as his truck will call at 4:00 P.M.

The party chief finds his party expenses falling into more desirable limits. He has also a more compact and mobile party.

There is no need for the one-truck-six-man combined unit to cause long hours. Both groups have ample time to do their work, both having the same working hours in an eight hour period. The level party assists the bench mark setter in loading his precast concrete monuments and the bench mark setter helps the level party by being prompt at 4:00 P.M. Nothing is more discouraging to a five-man level unit than, after a hard day's work to have to match to see who goes back on a long 10 mile stretch, by walking or hitch-hiking, to bring up the truck in order that all may ride back to camp.

It is my belief that all parties could quickly reform their units to the one-truck-six-man combined unit. I have used the above unit organization since November 1934, and greatly prefer it to having separate observing and bench mark parties. Were additional trucks made available for this party, it would be my desire to use the additional trucks only as supply trucks in hauling precast bench mark posts to more strategic points.

Disregarding the economy in the combined unit, it is my belief that better bench mark monuments can be had where the monument setter is closely associated with the observer. The observer is usually a technically trained man whereas the monument setter is rarely so. An exchange of ideas at all times will greatly improve our monuments.

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SPECIFICATIONS FOR HOISTING BAG

C. I. Aslakson

I am submitting herewith, the specifications for the hoisting bag which has been used on this party with most satisfactory results ever since its organization.

I strongly advise that the pigtail be run through all four rings and securely tied instead of using snap rings. My experience with snap rings shows them to be unsafe as they may become twisted and fail.

Specifications for Canvas Hoisting Bag

MATERIAL:
Good grade #4 white duck.

DESCRIPTION:
Bag to be 2 ft. wide, 2 ft. long and 2 ft. 10 in. deep with a 1 inch double hem at the top. Edge of this hem to have small cord hemmed in.
Bag to have double bottom, this double bottom to extend 6 inches up side.

STRAPS:
Bag to have two 2-1/4 inch straps, 7 ft. 6 in. long doubled and stitched onto the bag as follows: Straps are to be crossed at bottom on outside and in center of bag and stitched up sides to a point 12 inches from upper edge of bag where they will be firmly reinforced. The loose ends of each strap shall have a heavy 2 in. harness ring sewed into the loop. The web straps shall be reinforced with leather on inner side at the front where this ring is fastened.

WORKMANSHIP:
Workmanship must be of the best. Seam to be sewed with good strong thread.

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- - - STRETCHED END TO END

1. If all the walking incident to the extension of this leveling were put together, it would be the equivalent of two round trips between New York and San Francisco or, roughly the distance from New York to Singapore.

2. If all recorded observations and computations were typewritten on a standard typewriter, without spacing, and in a single line, the line would extend about 31.7 miles, or would completely cover a four-foot strip on one side of the Washington Monument from the base to the tip.

3. If all the numbers and letters on the abstracts and in the record books were printed on a single-spaced eight-column calculator, they would require a strip of paper 57.2 miles long.

--(From Season's Report of W. M. Gibson.)

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TRIANGULATION IN THE ATCHAFALAYA BASIN

The topography of the areas surveyed varied from rolling farm land in Iowa and Missouri to mountainous regions in Arkansas and Oklahoma, to rolling pastures and woodlands in Texas, to densely wooded swamps in the Atchafalaya Basin.

The greater part of this project was just another routine assignment of triangulation using steel towers. The survey of the Atchafalaya Basin was unusual in that the only possible means of transportation for this area were boats. This survey was made at a time of very high water. Inasmuch as nearly every station in the scheme was located between the protection levees of the Atchafalaya River it was very difficult to find ground of sufficient height above the prevailing water level to permit the location of a station and the erection of a tower. Several stations called for in the reconnaissance had to be omitted due to the flooded condition of the proposed station site. Several towers were built where it was necessary to throw up dams to prevent water from running into the anchor holes. Some stations were located on isolated knolls just large enough for a tower. In such cases azimuth and reference marks were wedged into drill holes in firm cypress trees that were crooked enough to more or less eliminate the possibility of their being cut down for lumber.

--- (From Season's Report of Charles A. Schanck.)

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ROAD METHOD FOR TRAVERSE USED ON THE TAMIAMI TRAIL

H. Edward Breen

This method is a cross between the rail and stake method. The measurements are made with the tape supported at 0, 12-1/2, 37-1/2, and 50 meters. Along a road, however, each tape end, and the intermediate supports must be lined in, thus including part of the stake method. Where the road work would continue along a true tangent, and an offset from the edge of the road could be used, the lining in might be eliminated. This could not be done on the Tamiami Trail.

Kilo points were made by a spike similar to the turning pin driven into the road bed flush with the surface of the road. The kilo points were held by 3 nails driven into the road.

Over the tar road, mixed with small gravel, the friction tape would not stick. This necessitated finding a substance that would stick and also keep the mark. Artist's model clay, called, "Plasteline" or "Permaplast" was used. The putty-like substance seemed to work satisfactorily.

A few slight changes were necessary on the rail equipment. The flange on the rail stretchers would have held the spring balance a trifle high. A new set was made at a tinner's shop of heavy sheet metal without the flange. The handles were interchangeable. The intermediate supports' guards had to be smoothed level with the base of the support in order to have the tape six inches above the road.

The method is much slower than the rail method and not as satisfactory as the stake method. The maximum kilometers run in one day were seven and one-half. Traffic along the highway slowed the work to some extent.

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EXCERPT FROM "MAPPING AUSTRALIA"

In a young country, the first necessity is to place the settler on the land, but as land becomes valuable, and the density of population greater, the responsible authorities must give consideration to surveys and maps of an accurate character which will show the exact locations of topographical features, private and political boundaries, as well as the configuration of the earth's surface. There is scarcely any human activity of an extensive nature whose successful operation is not dependent to a greater or less extent, on an accurate knowledge of the configuration of the surface of the earth, and of what is upon the surface. This knowledge can only be obtained by what is called topographic surveying and mapping, which, over a large area, can only be successfully carried out with the aid of a geodetic survey. To accurately map our country, therefore, is not only the goal of the surveying profession, but is a state to be achieved and highly desired by the many professions who require and use maps as a basis of their operations.

- -(From "The Australian Surveyor", June 1, 1935.)

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This excerpt from an article appearing in the Australian Surveyor of June 1, 1935, is interesting in that it points out the value and importance of topographic mapping in Australia, but which can easily be applied to any country which has not been thoroughly mapped. It is truly remarkable that practically every activity engaged in by man which is related to land, requires maps of some form. Engineers are well aware of the advantages to be gained by obtaining accurate maps of the country as a means of conserving natural resources, eliminating duplication and waste, and furnishing much desired information for all major construction projects. It seems strange that work of this character should not have been appreciated in the past, but now that people are becoming map conscious and actually find use for maps in nearly all of their daily activities, their great value is becoming more and more known. The situation in this country in many ways is quite comparable to that in Australia.

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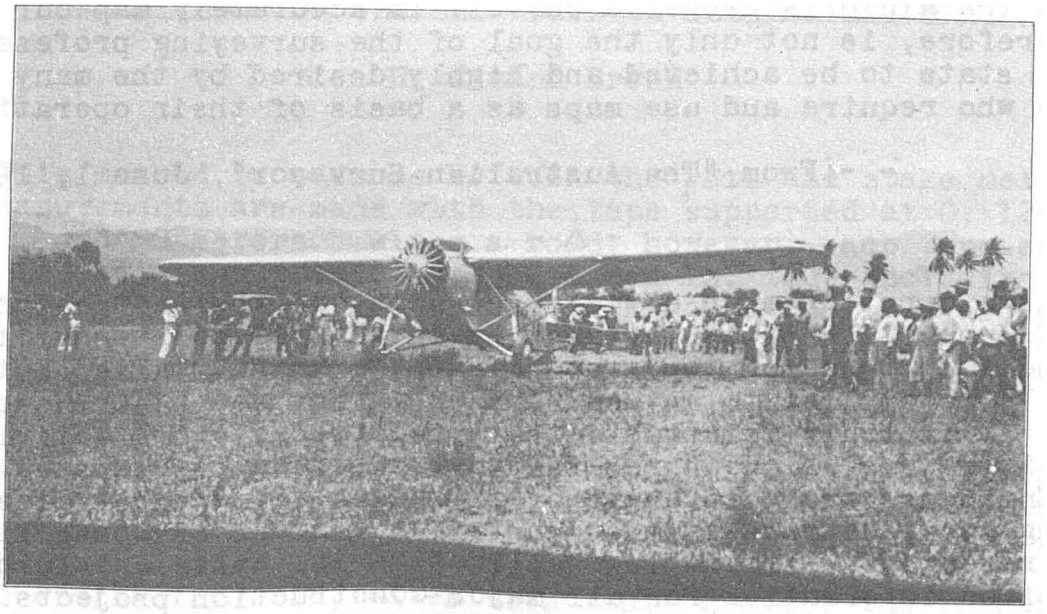
GUATEMALA-HONDURAS BOUNDARY

Joseph P. Lushene

In September, 1821, the Spanish colony now known as Central America, declared its independence from Spain and formed the Republics of Guatemala, Salvador, Honduras, Nicaragua and Costa Rica. Since this area was largely an unexplored jungle and consisted of only a few isolated settlements the descriptions of boundaries were indefinite and vague. No special stress was placed upon the exact limits of the various Republics. In later years as the countries developed and more settlements were made, boundary disputes arose between the adjacent countries.

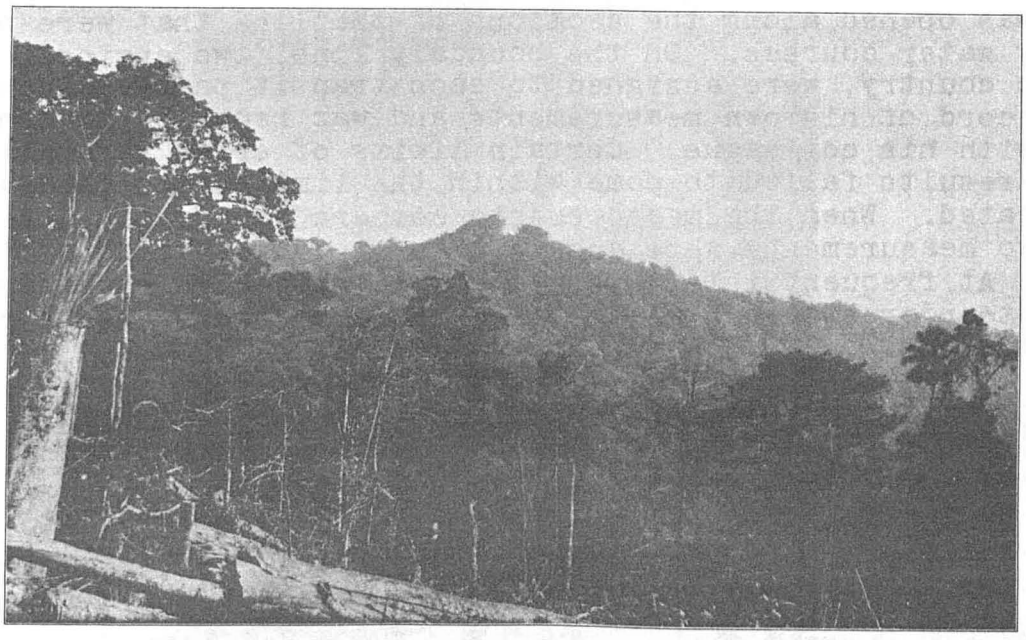
Many attempts have been made to settle the dispute between Guatemala and Honduras with no results other than the stirring up of additional hard feelings. However, in July, 1930, a treaty was signed and a Special Boundary Tribunal set up which consisted of the Chief Justice of the United States Supreme Court, an arbitrator from Costa Rica and one from Chile. An aerial map of the territory in dispute was made and the Tribunal made the award. After the award, it was necessary to mark the boundary line and a Technical Commission was formed for the demarcation. The U. S. Coast and Geodetic Survey was requested to carry first-order triangulation along the boundary since this method is considered the most satisfactory one for surveying a boundary. The writer was very fortunate in being detailed to undertake the control surveys.



Plane chartered to carry astronomical equipment into Honduras for the establishment of a station.

The boundary line is about 161 miles long. It follows water

courses, water divides, and in some sections, straight lines from one topographic feature to another. In general the line passes through highly mountainous country. The northern part of the line extends through sparsely inhabited country timbered heavily with tropical growth. There are practically no trails in this area and the few trails that do exist are very poor and impassible over the long rainy season. There are numerous areas that are absolutely uninhabited. Most of the traveling was done afoot and the equipment, food, and supplies were carried by natives. Trails had to be cut through the jungle growth to all stations and members of the party had to be armed against the wild animals. In the lowlands enroute to the stations, the temperature was hot and uncomfortable but at the stations it was very cold due to the high altitude of the mountains. The southern part of the line passes through fairly well settled country having numerous trails and in many cases, direct access to the boundary was possible. Most of the traveling was done by muleback and supplies were transported by pack mules.

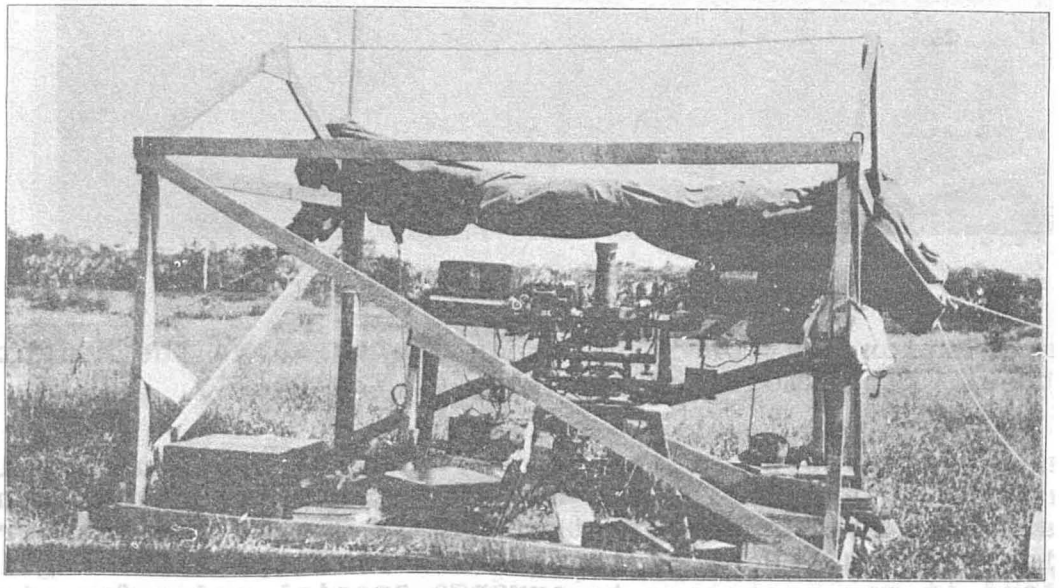


Triangulation station in distance. Notch shows the height of trees, also amount of cutting for visibility.

A base was measured at the southern end of the boundary in a valley and the triangulation ran northward from this line. The first few weeks the work progressed rather slowly due to the inexperience of the lightkeepers. None of the lightkeepers spoke the English language and it was necessary to arrange special codes for signaling at night. A double observing party was used on this work. Mr. Philip Welker, a computer from the U. S. Coast and Geodetic Survey, was in charge of the observing party which operated on the Guatemala

side and the writer was in charge of the other observing party in Honduras. Four-foot stands were used at nearly all the stations since the reconnaissance party had cut the heavy growth on all high mountain points which were to be used as stations. The greatest delay to the work was caused by cloudy weather which kept most of the stations in the clouds for long periods of time. Directions were taken to all boundary points wherever possible. Large tripods painted white were set up over the boundary points and directions taken during the day. Six to eight directions were taken on each boundary point and the positions computed so as to control the work of the stadia traverse parties running the boundary line. Thirty first-order points were occupied, and some thirty-three secondary points were established along the actual boundary. Very difficult field conditions were encountered throughout the work. At the majority of stations 10 or more days were required to complete the observations due to bad weather. A base was established at the northern end of the boundary as a distance check.

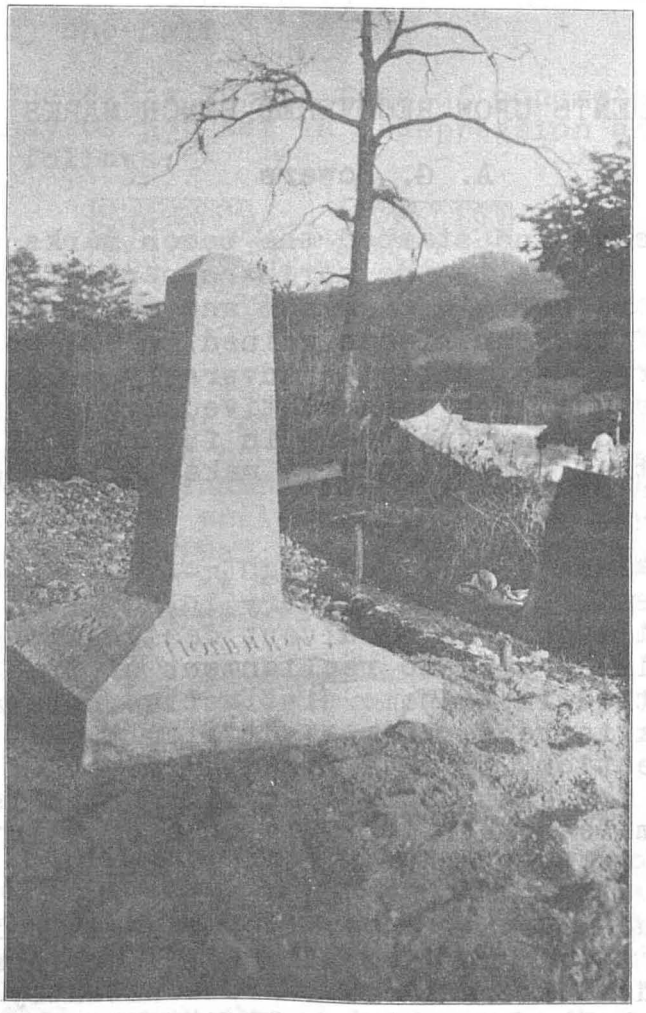
The actual boundary line was measured with transit and stadia. A vista was opened along the sections of the line that were not marked by water courses. On the boundary line, two engineers, one from each country, were assigned to each transit party. Each engineer made a record of his own measurements and was required to compare his results with his colleague. Certain limits of error were allowed and when the results failed to come within the limits, the observations were repeated. When the measurements compared favorably, the average of the two measurements were accepted as the final value of the measurement. At frequent intervals, points were located by intersection from first-order stations so as to control the measurements of the local engineers.



Astronomical Station

Upon completion of the triangulation work, astronomical observations were made at each end of the arc. At the northern end a

railroad passed very close to the station and the transportation of equipment was an easy matter. Latitude, longitude, and azimuth were observed. Since this astronomical station was in Guatemala the Commissioners from Honduras requested that astronomical observations be made also in Honduras. This problem became serious as no transportation facilities were available. The equipment for astronomical work is not only heavy but very bulky and could not be carried by mules over the poor trails. The problem was solved by chartering an aeroplane. The plane picked up the equipment at Chiquimula, Guatemala and landed in a cow pasture in Honduras at the southern end of the boundary line where the observations were made. The trip by plane was made in 30 minutes whereas it would have taken at least 4 days by mule travel. Having astronomical determinations at each end of the line made it possible to compute a temporary datum for the triangulation.



Guatemala-Honduras Boundary Monument

The forty-eight triangles along the arc had an average closure of 0.90 seconds and a maximum of 2.73 seconds. No difficulty was

experienced in closing the triangles. The work was carried on with a high degree of accuracy as it is the only system of precise triangulation in Central America and it was a means of training the engineers of the locality. Since the arc extends more than two-thirds of the distance from the Atlantic to the Pacific Oceans, it affords an ideal base for future extension of first-order control in this area. Various countries sent engineers to view the work in progress. When the computations are completed on this project, El Salvador will undertake to measure its boundary line with Guatemala. It is believed that this arc of triangulation will be connected with the precise net of Mexico, within the very near future, and also extended southward to Panama, thus giving all of Central America the North American Datum for control. A gratifying result of this short arc of triangulation is that Central America has become geodetic-minded. It is believed that much geodetic activity will soon be seen in this section.

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COMMENTS UPON RECOVERED BENCH MARKS

A. G. Bowers

Having recovered and stamped the bench marks on approximately 2,200 miles of levels in the northern part of California, it is thought that perhaps certain comments and suggestions may be in order as a result of the experience gained in the work. There is no intention, of course, to criticize adversely or destructively; my sole aim is to venture such constructive suggestions as I think might be of value to the Department in future work, and it is with that end in view that I respectfully make the following observations.

Bench marks along a railroad right-of-way should be tied in to some natural feature of the country in addition to the culvert designation and mileage. Both culvert designations and mile posts are changed sometimes owing to realignment of track, etc., and unless the mark is tied in to some distinctive natural object, recovery of the mark is rendered most difficult. It might be wise, too, in this connection, to have a standard way of designating the mile markers, as, for example: If the mile board is on a telegraph pole, call it a "mile pole", if it is on a post set especially for that purpose, call it a "mile post".

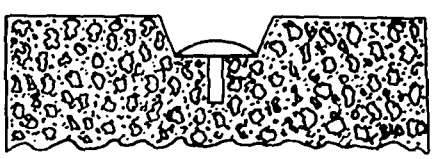
Listing of such elevations as "top of west rail opposite the station at - - -" should be discontinued, I believe. On practically all railroads the track crews are constantly going over the lines tamping the ballast, making ballast raises, etc., and the rail elevations may vary as much as half a foot. In such cases the elevations are worse than useless; they are misleading. If, however, it is decided to retain these elevations it is suggested that they be spotted very accurately and be tied in to some natural feature. Many of the small stations are on skids to facilitate

their removal from one spot to another, -- and a difference of 50 feet in distance on a 1.5 percent grade makes quite a difference in elevation.

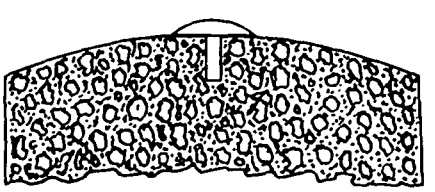
Along public roads the monuments should be set well out of the way of tractors and showplows. I came across a number of posts that had been tilted and even torn out. They should be in sheltered locations, yet free from likelihood of being covered by caving banks or slides. These precautions are especially advisable in mountainous country where the snowfall is heavy and snowplows operate regularly through the winter.

In setting the disks in culvert headwalls, would it not be wise to adopt a standard location, such as the center of the wall? Headwalls are frequently covered with earth or ballast, and if the center of the headwall is standard location the work of recovering the disk is reduced by one-half.

In setting the disks in the tops of concrete monuments it is suggested that they be <u>not</u> set in a depression as now seems to be the practice, as follows:



This, it seems to me, is the worst possible way to set them. Water can seep in under the disk, and when it freezes, can exert a disruptive force that is bound in time to heave the disk. If the top of the monument were chamfered this condition would be done away with, and in addition would make the disk more "get-at-able". In a number of marks examined difficulty would be experienced in getting a wide stadia rod on the disk because of its being sunk in a depression. The following sketch shows what I mean:



In nearly all instances the disks of the Geological Survey seemed more solidly set than did those of the Coast and Geodetic Survey. This, however, I think is inherently a matter of the shape of the Geological Survey disk which is flat and therefore bears on the concrete at all points of its under surface. In setting Coast and Geodetic Survey disks care should be exercised. They should be forced down into the mortar so that every part of the concave under surface is in contact with it. This will prevent water from seeping into what otherwise would be a cavity, in addition to making a much

more solidly set disk.

Some of the designating numbers and letters on disks are very lightly stamped, as can be seen in some of the rubbings. It is suggested that they should be deeply stamped.

In the mimeographed list of descriptions there is great difficulty in distinguishing a "3" from a "5" if there is any blurring. Of course, the elevation in feet can be worked out from the meter elevation and vice versa, but if both are blurred, inconvenience results. It is suggested that a different type, one that has the "3" and the "5" easily distinguishable and different from each other, be employed. It is a small matter but it usually is the most important figure that is blurred and hard to make out.

Beyond the small and relatively unimportant matters referred to above, I have no criticism of any kind to offer. My work convinces me that the Coast and Geodetic Survey well deserves its fine reputation for skill, care, precision, and foresight, and to say that I have enjoyed working in such an organization is putting it very mildly, indeed.

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COMMENTS ON ABOVE

H. W. Hemple

I think that you are misinformed as to the type of mark which is in use by this Bureau for bench marks and triangulation stations. While the surface of the mark is convex, the underside is flat, and there should be no reason why these marks should not be set as solidly as those of the Geological Survey. Our experience has been that it is advisable to countersink the mark slightly, but not to the extent, however, that the top of the mark will be below the surface of the concrete. If this is done, there is no question about the adherence of the other side of the mark to the concrete and no possibility of seepage underneath. I have had no complaints regarding our marks being uprooted in the concrete by freezing due to seepage underneath.

Regarding the light stamping of the numerals, the bronze alloy we use is very resistent to corrosion and abrasion. It is, therefore, quite hard, and unless the man setting the marks takes sufficient trouble to strike the die quite hard, it will result in a very shallow number. It is the opinion of this office that it would be inadvisable to use a softer alloy because such would be more susceptible to corrosion. There is no reason why the man establishing the mark should not strike the steel die sufficiently hard so that the number will be quite legible. There may be isolated cases where this criticism holds, but I do not think that throughout the country there is much difficulty on the score mentioned by you.

Regarding the location of monuments along public highways and railroads, the instructions for leveling specify that the location should be such that it will not be disturbed by highway or railroad activity. We realize, of course, that marks may occasionally be set along unimproved highways, and as the road is rebuilt it may possibly be widened, with the consequence of the destruction of the marks. This is something which cannot be adequately foreseen at the time the marks are established.

Marks set in culverts or bridge heads should be so located by distances from the corners of the structure that it will be possible to locate the marks without much difficulty.

In the more recent typewriter purchases made in this office the machines have what is known as billing numerals. In this the lower part of the figure is open and the 3 and the 5 are easily distinguishable. Of course, ultimately the data furnished to you on the mimeographed list will be published in printed form and the difficulty mentioned by you will not appertain.

This office is always glad to receive constructive criticism such as advanced by you, and if at any time in the future any suggestions occur to you which might improve our work, I shall be glad to hear from you.

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FURTHER COMMENTS UPON DESCRIPTIONS OF BENCH MARKS

Howard S. Rappleye

I believe the comments concerning descriptions of bench marks located along railways, as mentioned in the second paragraph of Mr. Bowers' letter, are good though I am not so sure that we are justified in making the fine distinction between "mile poles" and "mile posts". This has been discussed considerably in the past and I am a little doubtful as to the value of this rather fine distinction.

With special reference to the third paragraph of Mr. Bowers' letter, the elevations of the top of the rail opposite railroad stations are not and never were intended to be used as bench mark elevations. We know that the top of rail is constantly being changed in elevation and anyone using a rail elevation as a bench mark for accurate leveling would be simply asking for trouble. There are, however, a number of uses for these rail elevations which perhaps have not occurred to Mr. Bowers. A great many people are interested in the elevation of places throughout the county from a casual or non-technical viewpoint. Rail elevations serve their purpose better perhaps than our standard bench marks, unless the standard bench mark happens to be located near some station or public building with which they are thoroughly familiar. There is also a use for rail elevations which perhaps has not occurred to Mr. Bowers, and that is in connection with mapping by means of air photographs.

Elevations at road crossings, opposite railroad stations and at important bridges can be used in making maps from air photographs without the necessity of putting a signal on the ground at the bench mark while the photograph is being taken as would be necessary with most bench marks. These rail elevations are practically ground elevations and are what the persons using air photographs need. There are other uses for rail elevations and, in spite of the fact that rail elevations are not accurate, except perhaps to the nearest foot or so, nevertheless, they do serve a useful purpose and form a valuable by-product resulting from our leveling.

Mr. Bowers' comment concerning the necessity of using care in locating bench mark posts so as to be out of the way of tractors and snowplows and also keeping them in locations where they will not be covered by caving banks is a good one. These points have been stressed in the past in writing various circulars concerning the desirable locations for bench marks.

With regard to the adoption of a standard location for the disks in headwalls, this might be advisable but very frequently it will be found that it is inconvenient or impossible to place a disk in a particular location adopted as standard and there would, undoubtedly, be numerous variations from this standard practice should it be adopted. It is certainly undesirable to place all bench marks which occur in culvert headwalls on the same side of the track. If they are staggered alternately first on one side of the track and then on the other, a double tracking operation cannot bury more than half of them, where it is possible that a double tracking operation might cover them all if they were on the same side of the track.

With special reference to the matter of countersinking the disks, it is true that disks are occasionally loosened as a result of water seeping under the disk and then freezing, but the loss of bench mark disks in the past from this cause has been nothing like as great as the loss resulting from vandals knocking them out if they are not countersunk. A disk which is not countersunk is rather easy to remove, provided one goes about it with a cold chisel or pick.

Mr. Bowers' comment concerning the Geological Survey disk being flat on the underside and ours being hollow underneath may apply to some of the marks which he recovered or found dislodged on the older lines, but the standard disk in use by this Bureau for a considerable number of years past is flat on the underside. Mr. Bowers' comments in this connection are undoubtedly correct insofar as his experience is concerned, but he is not in possession of all of the facts in this particular case.

Concerning Mr. Bowers' comment regarding the light or shallow stamping of the disks, I see no reason why the designation and the year of establishment could not be stamped deeply in the disk, but it is not too fantastic an idea to assume that the elevations may have to be changed in the future as a result of movement from natural causes or the necessity for some readjustment, either local or general, and in this case a lightly stamped elevation would be much

easier to cut out preparatory to restamping than an elevation stamped deeply as he suggests.

His comments concerning the quality of the mimeographed lists, especially as regards the distinction between the numerals three and five, is probably justified. We cannot, however, always choose the particular typewriter that we have to use and it is not always possible to get the very best mimeographing done on every single job. I believe that the number of cases where trouble has been caused through faulty mimeographing is relatively slight considering the mass of information which has been sent out in that form in the past two or three years.

Mr Bowers' suggestions, made as he says as a result of his experience in recovering bench marks along approximately 2,200 miles of lines, certainly deserve careful consideration, and where I have, in the above paragraphs, taken exception to his suggestions, it has been either because his experience has been limited to one particular section; he has not been in possession of all pertinent facts or we have found from experience that certain ideas which are theoretically sound from a certain viewpoint do not work out to the best advantage in actual practice.

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UNUSUAL LOCATION OF BENCH MARKS

John Laskowski

(Two bench marks were established for the U. S. Weather Bureau at San Francisco, California, one on the top floor and the other on the roof of the New Federal Office Building.)

In view of the unusual locations of these bench marks, it was necessary to follow an out of the ordinary procedure for the necessary leveling. After encountering several delays in locating suitable turning points, the leveling was carried to a point at one of the winding stairways of the building. A standardized steel tape was then used in carrying the elevation to the top floor by having the divisions of the tape coincide with the respective divisions on the invar tape of a rod which was held plumb by one of the party members, and then reading the tape on the top floor as it was stretched taut by other members of the party. Through this means a difference in elevation of approximately twenty-one meters was obtained with one setting of the instrument. This process was repeated in two steps to determine the elevation of the mark located on the roof of the building. As checks were obtained between the first forward and backward runnings of the section, the procedure is recommended for use in future similar instances.

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FLICKERING LIGHTS MYSTERY SOLVED

There is quoted below a brief article that appeared in the Oregonian of Portland, Oregon, on July 3, 1935. -

Geodetic Survey Under Way Here; Lights from Hilltops Explained.

The mystery of the strange lights flickering recently from the hilltops in the vicinity of Portland has been solved. A survey party of the United States Coast and Geodetic Survey is responsible.

For many years the United States Coast and Geodetic Survey has been carrying out a program of precise triangulation.

Due to better atmospheric conditions, the work is done at night with lamps resembling automobile headlights. These lamps are centered accurately over bronze disks set in concrete, which constitute the survey monuments and from which latitudes and longitudes are determined.

This is the cause of the flashing lights that have aroused local curiosity. Geodetic survey light tenders are flashing messages to the engineers operating the delicate measuring instruments, which are known as theodolites.

A theodolite is something like the surveyor's transit, except that it is more elaborate. It is an ordinary instrument with a college education.

In measuring angles in triangulation it is necessary to use a theodolite that will measure accurately to one second of arc.

The survey party which is extending triangulation through northwest Oregon is working under Norman Sylar and includes about 20 young engineers. Permanent stations have been reoccupied or established on Barnes Heights, Mount Scott, Rocky Butte, Vancouver, Chehalem Mountains, Mount Sylvania, Portland postoffice, Hillvilla and other points.

A great many secondary stations, including tips of smokestacks, water tanks and flagpoles, also have been observed on.

At a later date exact latitudes and longitudes will be available for all these points. These are necessary for map production and a wide variety of surveys.

The U. S. Coast and Geodetic Survey has another party in Oregon under Lieutenant Robert W. Knox at Astoria and is making a new series of charts of the Columbia River. It is also carrying on triangulation work close to the borders of the river. Work of the two parties is closely coordinated.

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SOME PROBLEMS IN ESTABLISHING TRIANGULATION STATION MARKS

Some time ago a series of questions were submitted to this office by a chief of party with the request that they be answered in the Geodetic Letter. The questions and answers follow:

1. In the case of a new station, should the azimuth mark be marked "Azi" or R.M. No. 3?

Answer: New marks have been designed and purchased for use as azimuth marks. In the future these will be used for all azimuth marks.

2. In the case of occupation of stations marked by other organizations;

(a) Should the station be remarked if not in good condition or should a new mark be established and a tie made to the other station?

(b) If the station is sufficiently well marked what stamp, if any, should be placed upon it?

(c) If additional reference marks are established, how should they be stamped?

Answer: (a) Station marks that are not in good condition should be remarked regardless of what organization established them. It is preferable to occupy the old station rather than to establish a new station and make a tie to the old one as connections by distance and direction often cause confusion.

(b) Stations of other organizations that are sufficiently well marked should not be stamped at all.

(c) Additional reference marks should be stamped with the name of the station followed by the initials (in parenthesis) of the organization which established the station and each reference mark should be given a number as in marking reference marks for our own stations.

3. Where old U. S. Coast and Geodetic Survey stations have only two reference marks marked respectively R.M. # 1 and R.M.# 2, one of which was used as an azimuth mark;

(a) What should be stamped on new reference marks placed?

(b) Should the azimuth mark be stamped "Azi"?

Answer: (a) New reference marks should be stamped with the name of the station followed by the next consecutive number as # 3 and # 4 and dated with the year the station was established, followed by the year the reference mark is established.

(b) The azimuth mark should be stamped "Azi".

4. Where old stations with # 1 and # 2 reference marks are recovered with one of the reference marks established, what numbers should be given the new reference marks?

Answer: They should be numbered # 3, # 4, etc., followed by the year in which the station was established and the year the new reference marks are established.

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REACTIONS TO GEODETIC LETTER NO. 5, MAY, 1935

(The full letters from which these extracts are taken will probably appear in a future issue of this publication.)

"I appreciate receiving a copy of the Geodetic Letter for May, 1935, on the use of geodetic control for boundary surveys.

"The twelve land banks under the supervision of the Farm Credit Administration are vitally interested in private boundary surveys in connection with loans on farm lands in all parts of the United States and it occurred to me that you might wish to send copies of your Geodetic Letter to the banks for their information in this matter. Accordingly, I am attaching a list of land banks with the names of the heads of the engineering departments for all except Districts Nos. 1 and 2 which have no engineers attached to the banks . . . ." (Mr. Thomas Hawthorne, Senior Hydraulic Engineer, Land Bank Division, Farm Credit Administration, Washington, D.C.)

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"The Geodetic Letter received and hope its contents will take legal place of beginning in our Texas survey matters.

"In early Texas history when surveying methods were under discussion, it was proposed to adopt the U. S. Land survey method, but when it was not done, one man said then, "Gentlemen, we will have to educate all our boys as attorneys to take care of the litigations" and so those of us who have made any degree of success as land surveyors, first had thorough legal training.

"I have put in several hundred miles of County Boundary lines during the past two years and have referenced to triangulation stations where I knew about them . . . . . " (Mr. A. L. Harris, County, District and State Surveyor, Lubbock, Texas.)

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"I was greatly interested in your recent Geodetic Letter containing a symposium on the use of plane coordinates and the legislation in the State of New Jersey. It is very well written and the matter convincingly presented, and I hope that you will be able to give it a wide circulation.

"It is most important in getting this method of describing property generally adopted to make it at first legally permissible without being mandatory. Most of the smaller property surveys and descriptions are made by surveyors whose knowledge of geodesy and geodetic surveying is very limited, and they will not study the subject or change their methods except as they see by actual demonstration that the old system is being superseded by a better one. They will have to see the new system in use to be convinced of its advantages, and the sooner its use is allowed the sooner will its superiority be recognized; but to make it mandatory before they are thoroughly familiar with it would result in much confusion and in many errors. . . . ." (Mr. Gordon Macleish, Civil Engineer, Santa Barbara, California.)

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"We wish to thank you for the copy of the "Geodetic Letter, No. 5, Volume 2, of May 1935". The subject matter presented has been read thoroughly and we wish to place ourselves on record as desirous of receiving any further letters that may be written along these lines.

"The matter of using the national triangulation system for control of local and private surveys and descriptions, is of great importance to the Rancho, and we only regret that such control was not made compulsory by California legislation years ago.

"Within the rambling boundaries of this old Spanish Grant, comprising some 203,000 acres, no sectionizing was done by the United States. Consequently, we have had nothing in the way of monumentation upon which to hang numerous maps, surveys and lease descriptions other than the exterior boundaries and corners of the

Grant. Some of these maps are quite extensive, the compilations of thousands of dollars worth of survey works, accurate within themselves no doubt, but uncorrelated, tied to little or nothing, and floating in space. Triangular control with rectangular coordinates tied into the national system, applied to these surveys in the first place, would have made of each map a piece of complete mosaic fitted accurately to its place.

"Having of late come into possession of the geodetic data of the U. S. C. & G. S. Stations strung along the coastal boundary of the Rancho for some twenty-five miles, we are now endeavoring belatedly to achieve such correlation with the old maps and insisting that all future surveys shall be properly tied to the national system unless too remote to be practical." (Mr. Harry L. Heffner, Manager, Rancho Santa Margarita, San Diego County, California.)

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"Your Geodetic Letter No. 5 Vol. 2, of May, 1935, received and read with great interest.

"I am glad something in this line has been done, and hope it will awake the Engineering profession as a whole to the many advantages we would gain by having most of our work tied in to the U. S. Coast and Geodetic Survey, and thereby it would "pave the way" for us in getting a bill passed, in establishing a system of plane coordinates for our State, and to start with, have our system of State Highways and all new resurveys by the General Land Office, tied in to the U. S. Coast and Geodetic Survey. Thus we would gradually work up to having most of our important work tied in to the above system.

"If we only could get started in the right direction, so that people would have a chance to become educated to the permanence of this work, they would begin to demand it, and by that time the Geodetic markers would be closer together, and it would become comparatively easy to make the required ties. . ." (Mr. J. A. Gjelhaug, C.E., Chippewa National Forest, Cass Lake, Minnesota.)

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A FEW TRICKS IN RECONNAISSANCE

L. G. Simmons

In profiling a line or determining the relative position and elevation of a proposed triangulation station or prominent object, particularly in fairly open country, there are some short cuts available to the reconnaissance engineer which not only reduce the time but also increase the accuracy in obtaining this data. Fol-

lowing is a description of some methods used in the field to this end. Instruments required are a hand azimuth-compass, transit with vertical circle (reading to one minute is sufficient), a tape at least 100 feet in length, and a slide rule. The last mentioned is not necessary, but is of great convenience.

Many times each day, during the course of triangulation reconnaissance, the knowledge of the distance and relative elevation of a water tank, hill, tree, house or some other object, becomes highly desirable, either in determining the position and elevation of the object itself, or the reverse; i.e., the determining of the position and elevation of the observation point from a known object.

The distance and relative elevation of an object not more than 12 miles or so away can be determined in 5 or 10 minutes with an accuracy of about 0.2 mile and 5 to 10 feet of height. No mathematical tables are needed. All that must be known is that the earth's curvature in feet equals 0.574 times the distance squared (in miles) and that an arc of one minute is subtended by $1.53\frac{1}{2}$ feet at the distance of one mile.

Figure 1.

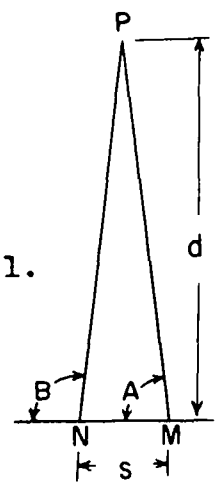
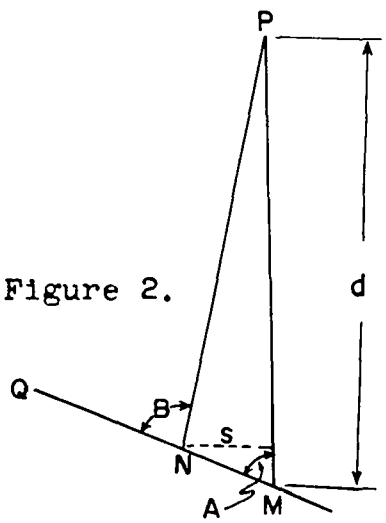


Figure 2.



Consider Figure 1. Required the distance (d) from the instrument position at "M" to an object at "P". (The angle in this figure is greatly exaggerated.) Select a point "N" at a distance of "s" feet from "M" and at about a right angle from "P". Measure angle A; then set over point "N" and measure angle B. Angle P then is equal to B minus A. In other words a distance of "s" at the observation point subtends an angle of "P" at the distance "d" of the object concerned. The distance "d" then becomes $s/1.53\frac{1}{2}$ P; "d" being in miles, "s" in feet and "P" in minutes. The principle involved here is, of course very simple. Difficulties arise, however, in actually accomplishing this measurement in the field in a reasonable time and with an accuracy sufficient to make the result of any value. It will readily be seen that the instrument must be very accurately centered over M and N, which, in windy weather would take considerable time. This difficulty is overcome by first selecting a second distant object "Q" anywhere from about 1/4 mile on up - the further, the better. And this

object does not necessarily have to make a right angle with "P" but any angle - say from 35 degrees to 145 degrees. The nearer this angle is to 90 degrees, however, the more effective will be the base.

The instrument is now set up over M and sighted toward Q (see Figure 2) and the point N lined up with Q at a distance of, say, an even 100 feet. Angle A is now measured using Q and P as sights, and, leaving the plates still reading angle A, the instrument is set over N and the angle B is "unwound" from P to Q, and what remains on the plates (negative in this case) is angle P. In case angle B is measured first, then the value P on the plates will be positive after the mechanical subtraction. If a minute transit is used and the distance "d" is very great, angle A should be "wound up" three times at M and "unwound" three times at N, leaving a value of 3P (negative) on the plates. The 100 foot base (MN) is reduced to the effective base "s" by multiplying by sin A (slide rule). If "d" is about 10 miles, an error in the base of one foot will affect the result only about 0.1 mile; and an error of several inches in the alignment of point N, if Q is at a considerable distance, will have no appreciable effect in the result. Point M need not be marked on the ground at all, and N only with a rock or stick until the instrument can be placed over it. No plumb bob is needed. The instrument can be placed over N by eye closely enough. If one man is working alone, the point N can be occupied with the instrument first and M then lined up with N and Q by eye, hooking the tape to the instrument over N and backing up, say 100 feet, and dropping a rock in line at this distance.

For distances "d" up to about 5 miles, an accuracy of better than 1/4 mile can be determined merely by setting up at M, measuring A, picking up the instrument and pacing 100 feet toward Q and "unwinding" angle B at N. Points P and Q may be the top of a water tank, gable of a house, branch of a tree, rock on a hill or any object on which a fine pointing can be made. A greater accuracy can be obtained by increasing the length of the base, but 100 feet is sufficient for distances up to about 12 miles, and is convenient when a 100 foot tape is used. The relative elevation of P can easily be determined, of course, from the vertical angle to it, after the distance is known. Many times during the profiling of a line the elevation and distance of an intervening possible obstruction are desired. These can be determined with sufficient accuracy by the "pacing" method mentioned above, in about two minutes of time.

In open country, relative elevation of all stations can easily be determined from prominent objects such as water tanks, grain elevators, hills, etc., and in sectionized country where all points can be plotted accurately, there is no need for the measurement of distances, merely of vertical angles. This reconnaissance party has been supplying elevations of all stations after making ties to known sea-level elevations. At times it has been as much as 200 miles between ties, but the elevations have never failed to check

better than 25 feet except once when the error was 40 feet.

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Once the relative elevations and distances between stations of the reconnaissance are known, there is a very rapid method (in open or fairly open country) in determining the height of signal that will be certain to clear the line. The field work consists only of taking the maximum vertical angle to anything on line from each end of the line; i.e., set up at one station, point the telescope to the other by means of a compass, and tilt the telescope upward until the center horizontal hair just clears everything on line, allowing, of course, for small errors in horizontal pointing, and read the vertical angle. This process is repeated at the other end of the line. The point where these two verticals meet represents the worst possible obstruction in the line, and if signals are computed and erected to clear this point, an obstructed line cannot result. However, if the objects to which these vertical pointings were made from each station are at a considerable distance along the line, the computed signal height will be too great. The nearer these two objects are, the more closely the computed signal heights will represent those necessary to just clear the line. It very often happens that the two verticals are taken to the same intervening ridge, line of trees, buildings or other obstacles; or, if not the same, to obstacles fairly close together. When this is true, no better determination of the necessary signal height can be made. It also happens very often that the signal heights computed in this way are equal to or lower than those needed over other lines, and further investigation of the line in question is automatically eliminated.

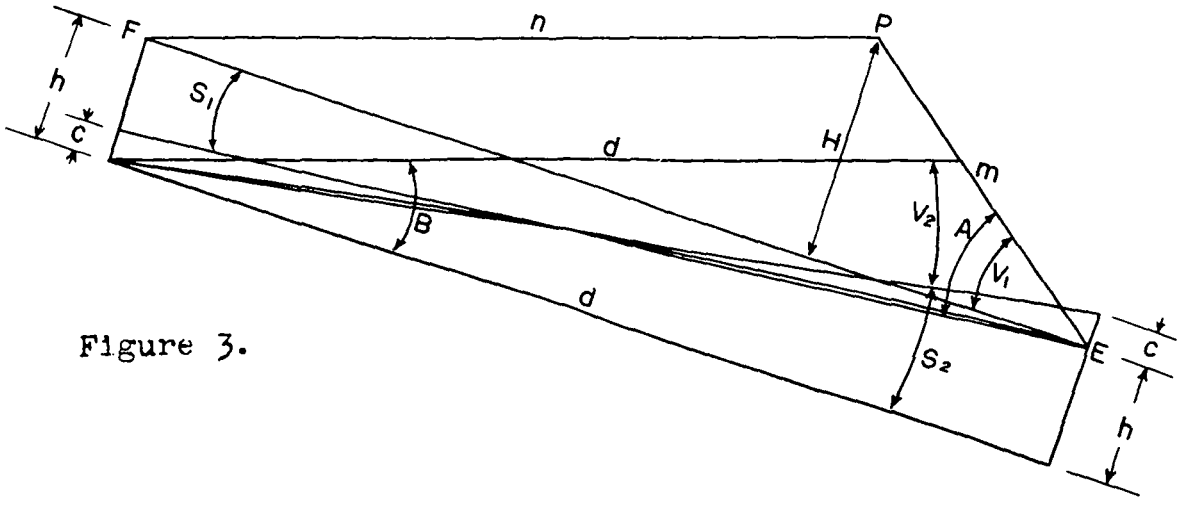

Figure 3.

The solution of this problem is indicated below. Consider Figure 3:

E and F are the stations at each end of the line in question.
d is the length of the line in miles.

V_1 and V_2 are the maximum verticals in minutes taken from E and F respectively.

S_1 and S_2 are the actual slopes of the lines EF and FE computed at E and F respectively, taking into consideration the difference of elevation between E and F and the curvature over the line EF. It will be seen that these slopes (expressed in minutes in this problem) are different, as the curvature will have a negative effect in one case and positive in the other.

P is the point at which the two maximum verticals meet.

H is the vertical distance between P and the line EF, in feet, and is the signal height necessary at both E and F to clear P.

m is the distance, in miles, from E to the point P.

n is the distance, in miles, from F to the Point P.

A is equal to V_1 minus S_1 and B is equal to V_2 minus S_2. Both A and B are in minutes.

The curvature over the line EF is $.574d^2$.

Assuming "h" to be the difference in elevation between E and F, (F the higher station) expressed in feet, then

$$S_1 = \frac{h - .574d^2}{1.53\frac{1}{2}d} \quad \text{and} \quad S_2 = \frac{-h - .574d^2}{1.53\frac{1}{2}d}$$

A and B then can be readily computed from the above formulae.

Now, as A and B are relatively very small angles, we have

$$\frac{A}{B} = \frac{n}{m}, \quad \text{and } m + n = d.$$

m and n can quickly be solved on the slide rule, by setting up the ratio $\frac{A}{B}$ and running the glass along the rule until two quantities are found which add up to d.

H then equals $1.53\frac{1}{2}$ mA or, for a check, also equals $1.53\frac{1}{2}$ B.

The height of signal needed to clear P then is H feet at both E and F. In case equal signals are not desired (a higher signal may be needed at one station for some other line, thus making it possible to reduce the signal at the other station) then, for example, if the signal at E is raised 26 feet, the signal at F may be reduced $\frac{n}{m} \times 26$ with safety.

The above solution may appear a bit too formidable for field use, but a very small amount of practice has proven that it can be done easily in three minutes of time. This method of computing signal heights makes it unnecessary to get on the intermediate point for instrument work, and as the maximum verticals taken are to the top of the obstruction, no separate measurement or guessing of tree heights or building heights need be made.

Of course, there are types of country where these methods will be of little use, but it will very rarely occur where at least a modified form of one or all of these methods cannot be employed to advantage.

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MONTANA EARTHQUAKE OF OCTOBER 18, 1935

In Japan and the western part of the United States, surface movement is a not uncommon accompaniment of severe earthquakes. In Japan geodetic work almost automatically follows such an earthquake. In the Idu shock of 1930, precise levels were in progress in the epicentral region and rerunning of the lines was almost immediate and was carried on while strong aftershocks were still in progress.

The geodetic parties of the Coast and Geodetic Survey have during the past ten years, made geodetic surveys in regions of seismic activity to determine the movement of the ground when an earthquake occurs and to secure data that could be used in making studies of earth movements of future earthquakes. Levels were repeated after the Long Beach earthquake of March, 1933. In addition, levels were rerun in the central region of the northern Utah earthquake of July, 1934, and levels were run in the region of the Cedar Mountain earthquake of December, 1932, though there were no previous levels for comparison.

From October 12 to 18, 1935, there were more than 200 shocks of varying intensity which were felt most strongly in the vicinity of Helena, Montana. The one on October 12, was particularly strong but the main shock was on October 18 and resulted in the loss of several lives and $3,000,000 damage to property. Cracks in the ground were reported to the northwest of Helena. Mr. F.P. Ulrich, in charge of the strong motion work of the bureau in California, proceeded with his assistant, Mr. D. S. Carder, on the day following the principal shock and by the night of October 21, he had two instruments for recording strong motion set up in the Federal Building at Helena. He recorded a considerable number of aftershocks. He also made other investigations in connection with the earthquake, among them, an attempt to outline the area over which geodetic work might be called for. The first epicenter as determined from telegraphic reports was about 40 miles northeast of Helena but with more reports it became evident that it was within ten miles of the city. This was confirmed by the distribution of the damage and by the records of the aftershocks which indicated that the point of origin could not be far away.

Immediately after the earthquake, Mr. Francis A. Thompson of the Montana Bureau of Mines and Geology, requested the bureau to repeat geodetic work in the vicinity. While no such work has been done in the vicinity of Helena for the main purpose of laying a foundation for earthquake studies, there are many lines of levels in the region and also triangulation. There is, therefore, ample opportunity to obtain useful results by repetition of either class of work. However, it is not likely that the work can be done in the near future unless additional funds are provided.

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REPORT OF PROGRESS

Triangulation:

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

First-order - - - - - - - - - - - - - - - - -	157
Second-order - - - - - - - - - - - - - - - - -	0

* Completed during September, 1935:

First-order - - - - - - - - - - - - - - - - -	0
Second-order - - - - - - - - - - - - - - - - -	0

Total miles of triangulation completed to September 30, 1935:

First-order - - - - - - - - - - - - - - - - -	61,357
Second-order - - - - - - - - - - - - - - - - -	5,527

* Most field work ceased in August due to lack of funds.

Levels:

Lineal miles of levels completed during August, 1935:

First-order - - - - - - - - - - - - - - - - -	61
Second-order - - - - - - - - - - - - - - - - -	318

* Lineal miles of levels completed during September, 1935:

First-order - - - - - - - - - - - - - - - - -	260
Second-order - - - - - - - - - - - - - - - - -	29

Total miles of levels completed to September, 30, 1935:

First-order - - - - - - - - - - - - - - - - -	106,601
Second-order - - - - - - - - - - - - - - - - -	154,805

* All progress for September is releveling.

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December, 1935

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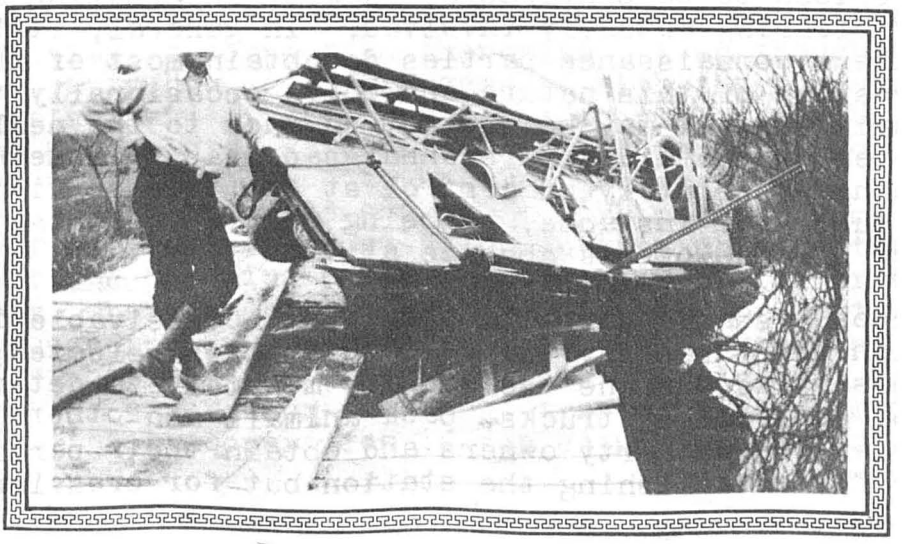
JUST ONE OF THOSE THINGS

Failure of private bridge 26 miles from nearest habitation in Encinal, Tex. Truck driver had to walk back for assistance. Bridge was torn down, truck eased into the stream then pulled out with winch truck. The bridge was then rebuilt.



COOPERATION BETWEEN RECONNAISSANCE AND TRIANGULATION PARTIES WITH ESPECIAL REFERENCE TO CONTACTS WITH THE PUBLIC

C. L. Garner

Chiefs of reconnaissance and triangulation parties frequently make recommendations to this office with regard to the necessary details of work which they say should be accomplished by the other organization so as to facilitate their own part of the field work.

Because of this it seems important to contrast the character of the work of the reconnaissance and triangulation parties for the purpose of bringing out the essential features which should be performed cooperatively by each of the parties in order to avoid duplication and to accomplish the completed field work with the least effort and cost. It must be borne in mind constantly that once the survey work is completed, the station marks are the only tangible results remaining from it, and in order that the greatest use may be obtained from these marks it is necessary that they be of service to the greatest number of people for the greatest possible length of time.

Triangulation parties sometimes complain that their building parties and lightkeepers have been delayed in reaching the stations for want of accurate descriptions of the routes to the station; lack of information as to the availability of pack animals and supplies; whether boulders or outcropping bedrock will make it possible to install the marks in them or if concrete marks will be required; whether the stations may be reached by pack animals the entire way or only partially so; lack of specific estimates of the heights of signals required or, if clearing is decided to be preferable, lack of information as to the amount of clearing actually involved. In general, it is believed that the reconnaissance parties do obtain most of the essential information of this nature and while occasionally there may be some omission, it may be due not so much to the negligence of the person who did the reconnaissance as to something over which he had absolutely no control at the time he visited the station; such, for instance, as being unable to contact the property owner because of his absence at that time.

For a reconnaissance party to obtain all conceivable information which might be of value at each station selected, it would be necessary to examine the country minutely to determine every route of approach by trucks, pack animals and otherwise, and to interview the property owners and obtain their permission not only for establishing the station but for crossing the

land in getting to the station. Many times people are not at home and for the reconnaissance party actually to interview and obtain the necessary permission for every possible operation might require as much as several days for a station. The triangulation party rarely needs all of such information because, in the majority of cases, the approach to the station described by the reconnaissance party is the only one that is practical and the remainder of the work would be useless.

Reports from triangulation parties indicate that there were a few stations which apparently were not visited by reconnaissance parties. The reports came from parties working in the west where most of the stations were on mountains or hills which did not require the use of towers. No station can be properly described unless it has been visited, and a poor description may easily result in the loss of a day's time to the building party and perhaps to the observing party as well. The average triangulation party, as compared to the reconnaissance unit, is composed of a large number of men who are working on a definite schedule and any interruption in their program causes delays which are expensive. All points therefore, regardless of how conspicuous or obvious their selection may be, should be visited by the reconnaissance man and an adequate description written covering the approach and other conditions so that there will be no possibility of the triangulation party being delayed. It seems particularly important that those in charge of both the reconnaissance and triangulation parties should have as their objective the completion of the entire project in the most efficient manner and with the lowest unit costs.

The matter of interviewing property owners for the purpose of obtaining permission for establishing the stations, entering or driving across their property, etc., is something which the reconnaissance party will never be able to do so thoroughly that the triangulation party will be relieved of responsibility in connection therewith. Even though the reconnaissance party has made arrangements with the property owner for the establishment of the station it will never be able to make such a complete explanation of what is to be done that the owner will be willing to have the triangulation party proceed through his premises and start work without some additional word of explanation. Ordinary courtesy demands that the foreman of the building party or the chief of the triangulation party, where practicable, interview the property owner before proceeding to the station. In such matters as these, property rights must be observed because it is only by contact with property owners and courteous treatment of them that we can obtain their cooperation in the establishment and protection

of our stations. Fences must be left in as good condition as when our parties entered the property. Gates should be closed and trucks should not be driven over the land any more than is absolutely essential. Ruts formed by driving trucks in soft land should be filled in on completion of the work since if they are left unfilled they become the beginning of washes at the first heavy rain.

Some of those engaged on triangulation recommend that the reconnaissance parties should select and temporarily mark the exact location of the station marks, reference marks and azimuth marks. Perhaps the reason behind this suggestion is the fact that frequently the station and azimuth marks are on land which is not owned by the same person. In such case, naturally, separate permission for the establishment of the azimuth mark is required and, since the reconnaissance party is smaller, the cost of the extra time required to obtain this permission would be considerably less if this particular part of the work were done by the reconnaissance unit. This difference in the cost of operation between reconnaissance and triangulation parties should never be forgotten by the reconnaissance man. However, it does not seem necessary or reasonable that the reconnaissance man should be required to definitely select the positions for all of the marks. Temporary marks are frequently disturbed or moved and this might easily lead to confusion or cause the building party to misplace the permanent marks.

It is always well for the foreman of the building party to proceed to the station slightly in advance of the building party in order to interview the property owner and explain that he is prepared to establish the station, build the tower, etc., and to initiate the triangulation for which the reconnaissance man previously obtained his permission. Such a contact is appreciated by the owner of the property because his rights are respected and he is impressed by an organization which proceeds systematically and explains reasons for and benefits of the work.

This question of contact with property owners is a very important one as it involves the protection and therefore the permanency of our stations. Chiefs of party who approach the owner in a courteous businesslike manner impress him with the valuable nature of the work and create in him a desire to cooperate heartily in maintaining the station. Where the triangulation party does not follow the reconnaissance party within a period of two or three months, it becomes necessary for the property owner to be interviewed all over again and be given a further explanation of the necessity of the work for many of them may have changed their minds or at least may need to be reminded of the previous contact by the reconnaissance man.

Some parties have a system of interviewing all property owners in advance of the building party and also use a form for reporting this interview. This same form passes through the hands of the building party, observing party and tearing down party and is initialed by each foreman or observer in turn. The use of this form by one party was very successful and no damage claims have been received.

Repeated contacts with property owners or other interested parties must not be considered as duplication of effort but as something essential in educating the public to the value of our work. In fact, the little extra time spent in explaining the purposes of our work and the value of our stations often gains a friend for the Survey.

The relations of our field parties with local people in these matters may be the deciding factor as to whether the Coast and Geodetic Survey will be regarded in a friendly or hostile way in that community. A single dissatisfied person can influence many people to his point of view, particularly when our parties have moved elsewhere and there is no one to come to our defense.

The same thing is true of correspondence between the chiefs of party and outside people, particularly property owners. Letters should be courteous, and should be written with the view to securing cooperation with the public through friendly dealings rather than by any brusque attempt to show the authority of the Government.

Many citizens undoubtedly feel that the Federal Government has the right of eminent domain and therefore they are hesitant to refuse our employees entry on their land or permission to establish stations on their property. But it is much to be preferred that permission for the station be granted because of a desire to cooperate with the Government rather than from a feeling of compulsion.

We know that eventually every property owner on whose land one of our stations or bench marks is located, will be benefited by it, and the work of our parties should be such as to educate them to this fact. When they see this, the information will be passed on to their neighbors and, from then on, our field officers will have very little difficulty in obtaining entrance onto private property for the purpose of extending our control work.

These sidelights on the relation between the reconnaissance and triangulation parties and the desire for more thorough cooperation between them in the accomplishment of the final task, is published with the hope that it will be read and studied by all of our field personnel. Comments are invited in order to obtain all viewpoints on the subject. Constructive criticisms will be printed in the Geodetic Letter.

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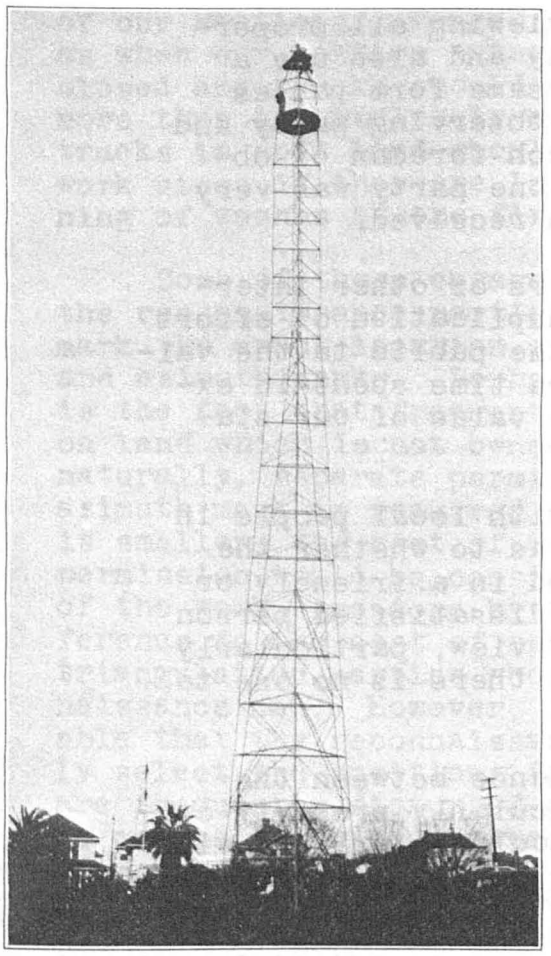
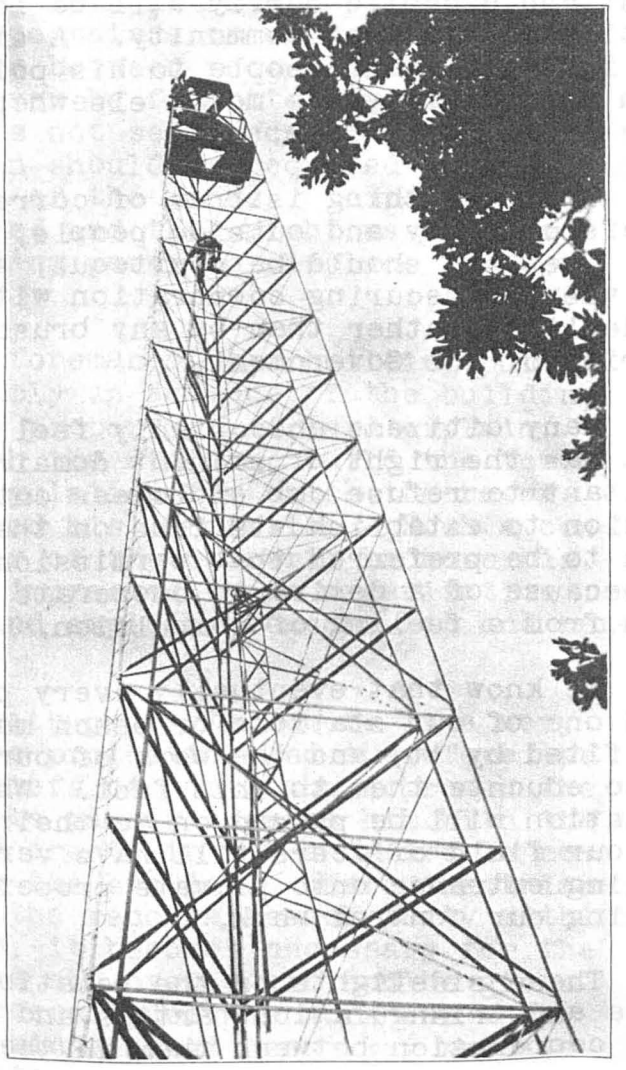


UP IN THE AIR

Steel tower, 123 feet high erected to see over obstructing tree tops at South Base, Palo Alto, California.



On the right is shown a Bilby steel tower giving a view of the intricate, detailed structure of the inner and outer portions of the tower as it nears completion.

THE COAST SURVEY

Under the general heading of "The Coast Survey" there appeared in the Princeton Review for April, 1845, a splendid article describing in some detail the purposes and methods of such a survey. While that article is too long to permit its being reproduced here in its entirety, the following excerpts should prove of interest to the readers of the Geodetic Letter. They form an excellent commentary on the firm foundations upon which our first Superintendent, Ferdinand Hassler, built this great organization. We are indebted to Prof. Philip Kissam of Princeton University, for calling attention to this article. ---Editor.

* * * * * * *

"Our readers who are in the habit of perusing the proceedings of congress, must have seen frequent notices of the important work now in progress in our country, called the coast survey. Yet from the tenor of the frequent inquiries we have heard in reference to this work, we are led to believe that there exists in the public mind generally no very definite idea of its nature and importance. We have therefore thought that a few pages of our review devoted to a popular exposition of the objects, the method of operation, and the history of the survey, would not be uninteresting to our readers; and perhaps be of some service in the way of enlisting public opinion more generally in favor of the work, and of a liberal appropriation of means for its proper and speedy completion.

"The principal object of the coast survey, is the formation of an accurate map of the outline of our extended seaboard, from its northern extremity in the state of Maine, to the limits of our possessions on the Gulph of Mexico; giving the latitude and longitude of the principal points, a minute delineation of the line of the shore, a sketch of the topography of a strip of the country parallel to the coast, an exact determination of the form of the bottom of the sea, within the space limited by the depth accessible to the ordinary sounding-line, the nature of the bottom, whether of clay, sand, or gravel, the position of bars, channels, and harbours, the direction and velocity of currents, the depth and temperature of the water, the bearings of the magnetic needle, and all other particulars immediately connected with the wants and improvement of navigation. In the accurate determination of these points of immediate practical utility, a number of results in the highest degree interesting to science will also

be obtained. Such as the data for a new determination of the form and magnitude of the earth; the variation of terrestrial gravity; additions to our knowledge of the phenomena of terrestrial magnetism, and other determinations of a purely scientific nature, which are regarded with the highest interest by the learned in every part of the world.

"The importance of such a survey must be evident to every one who reflects on the nature of the art of navigation, and its connexion with the commerce, and consequently with the prosperity of our nation. It is not, however, a work in which this country is alone interested, but one which affects the whole civilized world. It is a duty which every nation owes to every other, and to humanity in general, to furnish the mariner with an authentic delineation of its coast. The dangers which threaten the sailor in the midst of the wide ocean, are nothing in comparison with those which beset him as he approaches the land. With 'a seaworthy' vessel, and a wide space for unobstructed motion,he can laugh at the ordinary force of the winds and the waves. These, however,formidable they may appear to the inexperienced landsman, are formed of yielding materials, and usually spend their force in merely changing the direction of the vessel, or in urging it more rapidly on its way; but the mere suspicion of a sunken rock, the position of which is not precisely known; or the unexpected appearance of a breaker, is sufficient to strike with terror the mariner who would brave unflinchingly the lightning and the tempest. The alternatives of life and death, of wealth and poverty, are almost every day unavoidably staked by some one on the accurate determination of the position of a head-land, a sand-bank, or the true direction of the needle; and culpable must that nation be in the eyes of the world, who boasts of civilization, and yet does not furnish the data for these determinations...

"The ordinary methods of land surveying, are entirely inapplicable to a work of this kind. It is impossible to combine together the partial determinations of small districts so as to produce an uniform and consistent whole. The length of a line of forty or fifty miles, extending from one jutting point to another, across the water, is often required within a limit of error which does not exceed a few feet, or perhaps inches; and the position of points must be determined at the distance of many miles from land, to serve as the bases of sounding operations. The only method which can be employed to obtain accurate results of this kind, is one in which lines and angles are measured by means of trigonometry, combined with astronomical observations at the more important points. This method constitutes a branch of physico-mathematical science, to which the name of geodesy has been applied. Its origin is to be referred to the various labours which have been instituted since the time of the astronomers of Alexandria,

to determine the form and dimensions of the earth; but it has only been brought to any degree of perfection since the middle of the last century, by the labours principally of the English and French surveyors . . . . .

"It might appear, at first sight, that the process here described, is one of no great difficulty of execution, and that it could be safely intrusted to men of ordinary scientific acquirements. Indeed, such an opinion has been expressed in congress: but nothing can be further from the truth; and any line of policy in reference to the coast survey, founded on this opinion, would be attended with the most disastrous consequences to the success of the work. Every error of measurement or of observation, every fault of calculation or omission of circumstances, is increased and multiplied as the survey is extended, until they amount to discrepancies utterly inadmissible in an operation of this kind. To insure, therefore, the requisite degree of accuracy, all the resources of physical science, and all the appliances of the mechanic arts, must be brought into requisition to meet the difficulties which present themselves from time to time, under the constantly varying circumstances. The truth of these remarks will be evident from a more minute examination of some of the processes of the operation. . . ."

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AFTER THE STORM

Camp at Columbus, Nebr., after a tornado. No towers in this vicinity were wrecked.

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NEW JERSEY ADOPTS PLANE-COORDINATE SYSTEM

Philip Kissam

(Reprinted from Civil Engineering for November, 1935.)

On March 25, 1935, Governor Hoffman signed a bill that had just been passed by both houses of the New Jersey state legislature. This bill defines and adopts the plane coordinate system which has been devised for the state by the U.S. Coast and Geodetic Survey. Its enactment is one of the most important forward steps that has been taken in many years in the very old art of describing boundaries.

The idea of describing property by metes and bounds instead of relying entirely upon boundary markers like fences and streams, is believed to have developed in ancient times in Egypt, where the fertile lands bordering the Nile were cultivated after the annual flood had subsided and after all marks showing the boundaries of individual properties had been destroyed by the inundation. A crude form of surveying was developed which made it possible to re-run these boundary lines annually. When the compass became an instrument of some precision, the use of metes and bounds became an acceptable aid in the description of property. Owing to the various inaccuracies of the compass, its chief use was to aid in the recovery of old points marking the boundary, and for that reason it never became an acceptable primary method of finding the land.

With the development of the transit and the steel tape, a peculiar condition arose in regard to property descriptions. Over small areas an ordinary transit survey will locate the property as accurately as will markers. Thus descriptions by taped distances and transit angles were more and more relied upon by surveyors required to stake out property corners. However, the old custom persisted of describing the location of a property by reference to a point of beginning difficult or impossible to find, with resulting disagreements in the actual location of the land. Persons transferring property were advised to include in the description references to adjoining properties. Moreover, legal advice often indicated to the person selling the property that he would be more certain in his guaranty of title if he sold the property according to the description of it given in the deed by which he originally acquired it. Thus, partly owing to poor points

of beginning and partly to old recopied descriptions which were not accurate enough for the type of real estate involved, there has grown up in this country a peculiar situation -- there is no lack of the surveying skill needed to accurately locate property but the results are vitiated by improper methods of application.

Problem of Finding the Point of Beginning

Another factor that has had an unfortunate effect on the accuracy with which property is located is the importance attached to long and careful search of title. This factor accounts for the fact that descriptions of property have been worded so as to facilitate following the chain of title back to the original grant. This has also encouraged the tendency to use, not a modern description of property, but the original description as provided to the buyer of that particular division of land.

The land surveyor has thus been confronted with the problem of locating property by an old description and without proper points of beginning. Where the land is in a town, the point of beginning is usually described as being at a given distance and in a given direction from a street intersection. Usually no worse point could be chosen. Street intersections, being on public land and not subject to adverse possession, are not carefully watched, are poorly described, and are seldom officially marked. The determination of a street line becomes almost an impossible feat. Thus land surveyors have been forced to locate property by means of descriptions which do not agree with ground conditions.

A special technic has been developed, and it has become necessary to have especial information for each particular locality. Surveyors have often been obliged to do a large amount of research merely to lay out one piece of property. In order to get returns on this research, they found it necessary to resort to private marks to make it impossible for other surveyors to reap the rewards of their expenditures. More confusion developed. Title companies were obliged to employ staffs of surveyors so that it would be possible to locate property consistently over large areas.

With modern surveying skill, this sort of confusion, resulting in expensive boundary litigation as well as costly errors in the location of buildings and other structures, can be eliminated. If the confusion is to be entirely eliminated, however, one important principle must be followed. Throughout large areas points must be established and carefully marked by permanently set and thoroughly described monuments, completely

interconnected by surveys, so that the monuments can be replaced, when lost, by surveys from other monuments in the system. The lines and distances coordinating such monuments must be measured by surveying methods of the highest type. Rigid, accurate control for these surveys is essential.

Work of the U. S. Coast and Geodetic Survey

Starting well over a hundred years ago, the U. S. Coast and Geodetic Survey established a nationwide network of triangulation. To this system Canada and Mexico also tied in their triangulation, thus rigidly connecting all points throughout North America. In 1927 the geographic positions of all stations in the vast network were adjusted and established on a final datum. The positions of the stations resulting from this adjustment are referred to as being on the North American datum of 1927.

The arcs of first-order triangulation of which this network is composed average 10 miles in width and are generally spaced in the form of a grid system at intervals of 50 miles in each direction. Between these primary arcs are arcs of second-order triangulation reducing the distance between triangulation control stations to about 25 miles. Other work of the Coast and Geodetic Survey has further enlarged the areas controlled by triangulation. The State of New Jersey is particularly fortunate in having several thousand triangulation points within her boundaries, and within the next year the entire state will be property controlled by this net.

Employing men temporarily out of work, and initially through the use of Civil Works Administration funds, the Coast and Geodetic Survey established local control survey projects under its direction in every state of the Union, thus increasing the number of control points available. With the discontinuance of the Civil Works Administration program, these surveys were continued in a number of states under the Emergency Relief Administration. The Coast and Geodetic Survey does not now have control of these projects but acts in an advisory capacity to ensure that the results obtained are in accordance with the high standards of accuracy necessary for such work.

The greater part of these local control surveys have been made by transit traverses, with results having a ratio of error of less than one part in 10,000. The traverses are run from one triangulation point to the next, azimuth control being determined by special azimuth points set by the Coast and Geodetic Survey at every triangulation station. The field results are adjusted first for proper angular closure and second for traverse closure. In this way very accurate positions are determined for all points in the traverse. Monuments to mark

the traverse points are set in pairs, the monuments in each pair being spaced approximately a quarter of a mile apart, so that surveys starting from them will have adequate azimuth control. The pairs of monuments are set at two-mile intervals or less along important highways and important streets in towns.

Thus there is gradually developing throughout many states a complete control net of monumented points cohveniently and accurately located. The use of geographic coordinates for these points is too complicated to appeal to the local engineer. Since such coordinates are employed mostly for surveys of large areas, few engineers are familiar with their use. The necessity of developing some simpler system therefore became apparent. As plane rectangular coordinates are well understood and are easy to use, it was felt desirable to develop an adequate system of such coordinates.

The Coast and Geodetic Survey has adopted systems of coordinates for every state in the Union. The Lambert projection was used for states having the longest dimension east and west. Where the area was very large, two or more of these projections were used.

Transverse Mercator Projection for New Jersey

For states having the longest dimension north and south, the Coast and Geodetic Survey developed a novel and ingenious projection having many advantages. This has been called the "transverse Mercator projection". For New Jersey the meridian of 74° 40' west longitude has been used as the great circle which corresponds to the equator in the ordinary Mercator projection. Distances along this line have been computed from a point just south of the southernmost land in Cape May, actually the point where the parallel of latitude 38° 50' north intersects this meridian.

As the scale of a Mercator projection increases with the distance from the great circle assumed as the origin, it was arbitrarily made one part in 40,000 too small at the central meridian of 74° 40', in order to reduce the scale correction to a negligible factor. Thus, as the scale increases, the error becomes zero at lines drawn parallel to this meridian approximately 28 miles east and west of it. Beyond these lines, the scale of error runs up to approximately one in 40,000 too great at the easternmost point of the state on the Hudson River, and to approximately one part in 20,000 too

great at the westernmost point in Salem County on the Delaware River. The meridian of 74° 40' west has been given an east or x coordinate of 2,000,000 ft, and the intersection of this line with latitude 38° 50' north has been given a north or y coordinate of zero feet, thus placing all points in the northeast quadrant, where all coordinates are plus. The x and y coordinates can be distinguished by the number of digits.

Having arranged such a projection for the State of New Jersey, the Coast and Geodetic Survey computed the plane coordinates of nearly all triangulation points within the state boundaries for which the geographic positions had been determined on the North American datum of 1927. The geographic positions were not determined for the traverse monuments of the local control survey, plane coordinates being used instead.

In the greater part of the state, that is, between the 28-mile lines previously described, an accurate measurement in the field will give a distance slightly greater than that given by the coordinates of the triangulation points, whereas east or west of these lines it will give one slightly less than that given by the coordinates. For all but a few square miles in Salem County, the measured and computed distances agree within one part in 40,000 or better. As the accuracy of surveying work is seldom required to be better than that represented by an error of one in 40,000, this projection is a very happy one. The projection, or grid bearing of a straight line on this projection, is the same throughout the line, but the true bearings of such a line vary approximately one minute per mile for every mile traversed in an easterly or westerly direction.

Advantages to be Secured

The advantages of such a system are immediately apparent. Throughout the entire state, a surveyor making a connection with points on this system, and computing the coordinates of his stations by the usual method of latitudes and departures, will arrive at the correct coordinates, based on the New Jersey system. Given a pair of coordinates at each end of a line, the length of the line can be computed by taking the square root of the sum of the squares of the differences of the coordinates. The tangent of the bearing of the line can be computed by dividing the difference between the east coordinates by the difference between the north coordinates.

Thus there now exists in New Jersey a system of monumented points interconnected by surveys with their positions given on a plane-coordinate system extending throughout the state. When a property corner is described by coordinates based on this system, not only is the position of that particular corner capable of precise relocation but its position can never be lost. It is inconceivable that so many points in the system would be destroyed that no method would remain for accurately locating a particular corner.

France had a system of plane coordinates in the war zone, based on her triangulation net and computed by means of the Lambert projection. The landmarks destroyed during the war were reestablished after the cessation of hostilities by lines precisely located in their original positions as controlled by the remaining triangulation points.

The desirability of this arrangement is apparent to the most casual observer. The mechanics of its use for property descriptions involves certain considerations. The first essential is that it should be unnecessary for the surveyor to describe in detail in each deed the method by which the coordinate system was established. It was to satisfy this condition that the New Jersey legislature passed the act defining the basic system and giving it a name.

Because of considerations involved in search of title and the unfamiliarity of the system in general, it was thought unwise at first to describe property solely by coordinates. Until title examiners become familiar with the system and can compute lengths of sides and grid bearings from the coordinates of the ends of a particular boundary line, and until they become familiar with the coordinates of well-known landmarks, like streets in towns and old lines in the country, so that they can easily find a particular property and adjoining plots from the coordinates alone, it is recommended that the old form of description be continued with the addition only of the coordinates of each corner of the land described, and the following note included in the description: "Coordinates based on the New Jersey system of plane coordinates".

Besides the great advantage of permanency of location of property, several other major advantages of this system are apparent. With ordinary instruments magnetic bearings can be measured only very roughly, and variations in the direction of magnetic meridians are not charted with the degree of accuracy necessary for this type of work. True bearings based on astronomical observations are likewise not a

solution. The necessity of giving bearings more accurately than to the nearest minute of arc has long been realized. Unfortunately, because of the convergence of meridians, an east-and-west line 1,000 ft long in New Jersey would have a bearing at one end differing by as much as 12 seconds from that at the other end. The use of two bearings for the same line would require intricate computations and unnecessary detail in the work. Nevertheless, in order to reestablish a line of true bearings and observations on the North Star, just such computations would be required.

Grid bearings computed from the plane-coordinate system, however, are constant throughout the entire length of any line contained within the boundaries of the state. For the first time, bearings will have a definite meaning as well as being merely an adjunct to the description of angles. Deeds for adjoining properties having a common line will now give the same bearing for that particular line.

There are many reasons why the compilation of deed descriptions is necessary in certain areas. Tax maps, title examination, the acquisition of property by public agencies, all necessitate the preparation of a mosaic of lands made up from recorded descriptions. Because of different and inaccurate points of beginning and a lack of consistency in bearings, these descriptions seldom fit each other. The mosaic requires a degree of guesswork that often seriously vitiates its accuracy. Should old properties in such an area be described by plane coordinates, the compilation of such a mosaic would be a simple matter, and in many cases would be unnecessary.

A simple illustration will be given. When lots in the same block are supposed to abut along their back lines it is difficult to determine, by the use of present deed descriptions, whether the back lines do actually coincide. As a rule, the lots are described as fronting on their particular street, while the distance between the streets is usually a matter of question. Often a survey encircling the entire block is necessary, and even then guesswork enters into the final location of the common back line. When coordinates are used, this difficulty will be obviated.

Again, when rights of way are to be secured for the development of state highways, the vast cost of property surveys prevents proper study of the parcels of land to be acquired. Mistakes of a serious nature sometimes result. The state may actually acquire land that is never used and may fail to acquire some through which the highway passes. If

the properties along the route are described by plane coordinates, it will be necessary only for the center line of the highway to be properly tied to points on the coordinate system. The exact size and shape of the parcels to be acquired can then be obtained with facility. Modern planning calls for the acquisition of land by public bodies to a greater extent than ever before. Forest reservations, parks, riparian lands, highways, and public institutions are instances of the need for publicly owned areas. As this method of describing land is more widely adopted, the taxpayers of New Jersey will be saved large sums of money each year.

Full Use of System to be Attained Gradually

It is generally conceded that the full use and development of the plane-coordinate system must be attained by degrees. The advantages gained by the owner of property thus described should be pointed out by every thoughtful land surveyor. If a property is within a quarter of a mile of control points, it is believed that the necessary survey connections can be made without undue cost to the land owner. Areas of property described by coordinates will thus develop around the control points. Undoubtedly, in making these surveys, the surveyors will establish points that can be used as a basis for extension of the system.

When the public becomes aware of this system, there will be a demand for the use of coordinates in describing properties acquired. This will force private and public surveys to be run, extending the system even further. Many towns in New Jersey are already considering municipal ordinances requiring that the plane coordinates of property corners in new subdivisions be stated on the approved plans. Modern ordinances are being developed with the general idea that all subdivisions within a quarter of a mile of control points will be required to show coordinates of corners on the filed plan. Those subdivisions lying more than a quarter of a mile from these points will be prohibited from using standard coordinates, according to the present plan.

The law described provides a method for establishing official control points by any surveyor if he uses the method adopted by the U. S. Coast and Geodetic Survey for second-order traverse or triangulation work. Thus, subdivisions which wish such coordinates and which lie within a quarter of a mile of the present monuments can make use of them by establishing a traverse according to these requirements. In this way the use of the plane-coordinate system will be extended.

It is unnecessary to point out that the control points form a basis for all types of engineering surveys, not only providing a convenient and accurate method of checking and controlling these surveys, but also providing a horizontal datum which will automatically interconnect all surveys and maps based on this system. The engineering advantages of such a control system are sufficient to require its establishment. New Jersey has had the foresight to facilitate its use in property descriptions.

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CONTRAST IN CAMPS
BEFORE AND AFTER TRAILERS CAME INTO USE

1934

1935

Above 4-unit camp, April, 1934, Alexandria, La.
Below, 4-unit camp, May, 1935, Benjamin, Tex.

TESTING PRECISION INSTRUMENTS

Among the duties of the engineers of the Coast and Geodetic Survey is the testing of the extremely delicate precision instruments used in the various types of work of the Bureau.

The actual work of testing the instruments and standardizing them is complicated by the difficulty of finding a place stable enough for the work. Even a building as firm as the Department of Commerce Building, Washington, D.C., is not sufficiently rigid for the nicety of the results required. The ideal place for testing a theodolite or a gravimeter would be a large cave such as the Mammoth Cave or the Luray Cave. In a cave there would be no tremors from passing vehicles to disturb the instruments nor would there be any distortions of the form of the cave as the sun moved across the heavens, as is the case under present conditions.

In order to overcome the effect of any shaking of the building caused by passing trucks, or heavy machinery in the building, special piers that are entirely separate from the concrete basement of the Commerce Building, have been set deep into the ground. They are separated from the ground floor of the building by means of plastic material. With this arrangement the effect of the vibrations of the building are eliminated.

One especially difficult piece of work is the standardization of the gravimeter. With this apparatus the value of gravity is determined at hundreds of points in the United States for use in chemical and physical laboratories and in the search for buried geological structures - a matter of great importance in the location of petroleum, minerals, ores and underground water. The pendulum makes one oscillation in about one-half second of time, but the observations must be made so accurately that the actual time the pendulum takes to make an oscillation may be calculated to the ten millionth part of a second. One can readily see that the smallest tremors in the pendulum support would seriously affect such observations.

The other operation that requires great stability or rigidity of form is the testing of the theodolites used in triangulation. A special pier, somewhat similar to the one used for the gravimeter, has been erected in a room in the basement near the west wall of the building as a support for the theodolite. This pier is also entirely independent of the concrete floor. Instruments known as collimators, which are telescopes with cross wires and an electrical illumination to make the wires visible to the observer, are

arranged on brackets fastened to the walls of the building to serve as fixed points for the theodolite observations. Three of these brackets are fastened to the inside of the west wall. In spite of the fact that this wall is 37 inches in thickness, it actually changes its shape as the sun shines on it in the afternoon. The observations made in the forenoon of a cloudy day, or at night, are very consistent with each other and seem to show that the collimators remain fixed in position. On the other hand, the observations made in the afternoon of a sunny day have a progressive change in value and differ materially from those made under the ideal conditions described above. Therefore, the engineers of the Coast Survey have abandoned their efforts to test theodolites in the afternoon of sunshiny days.

The theodolite is an instrument similar to the ordinary surveyor's transit except that it is of more refined workmanship with superior optics and has a circle ordinarily 9 inches in diameter instead of 5. The position of any pointing of the telescope with reference to the graduations of the circle, is determined by micrometer microscopes which are read to single seconds of arc. One can realize what accuracy is obtained with this instrument when he considers that the two sides of an angle of 1 second diverge only 12 inches at a distance of 40 miles. In making the field triangulation observations which involve great chains of triangles extending in many directions over our country, the sum of the errors in the three angles of each triangle average about 1 second of arc. Usually, any one angle is accurate to one-half second which is equivalent to a relative error in the two sides of an angle of 6 inches at a distance of 40 miles.

The distance from the theodolite to the collimators fastened to the wall of the Department of Commerce Building is about 20 feet. Therefore, an error of 1 second of arc would be caused by a movement of the wall of approximately 1/1000 of an inch. The actual maximum movement in the Department of Commerce Building is approximately 6/1000 of an inch - an amount which would not disturb anyone except some of the engineers in the Coast and Geodetic Survey.

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THE MODERN TOUCH

The addition of Model T tires to his ox cart enables this traveling storekeeper, near Wrens, Ga., to make his rounds in comparative comfort.

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ONE HUNDRED YEARS AGO

(Editor's note: The following letter written more than a century ago by Ferdinand R. Hassler, Superintendent of the Coast Survey, (U. S. Coast Survey, Reports 1816-1848), indicates that then, as now, a need for topographic surveys and maps was felt by the various states; that the value of geodetic control for such surveys was recognized; and that it was felt that the major control surveys should be made by the Federal bureau, while the detailed surveys should be a state responsibility. When one considers that less than half the area of this country has been mapped to date, and that many of our maps are hopelessly out of date, one realizes that our first superintendent was just about a century ahead of his time when he wrote :

Washington City, January 9th. 1834

MOST HONORED SIR:--In the course of last summer, Professor Ducatel, of Baltimore, informed me that he and Mr. Alexander had been appointed by the legislature of Maryland to make a topographical map of that state, and inquired of me for a

plan of execution of the topographical part and its junction with the Coast Survey.

Mr Alexander visited me upon one of my stations, to witness my mode of operating.

When in 1816 I first began the Coast Survey, a similar desire was in the legislature of New Jersey, and Governor Dickerson offered cooperation by the interest he took in it; having, however, been elected a member of the Senate of the United States before I received the (too long delayed) authorization from the Treasury Department to treat upon the subject, and his successor, Governor Williamson, not entering into the same view, the whole was lost.

If you should find proper, in the present instance, to authorize such a mutual co-operation, the plan I then had would be equally applicable in this case as in the Jersey; a considerable part of the state lies equally in the necessary limits of the Coast Survey. This plan was - that I should be allowed, at the proper time in my work, to extend my main triangulation, at the expense of the Coast Survey, over the other parts of the state equally, and that, in compensation, the detail surveys should be made at the expense of the state, (as it would have to do at all events,) and dependent on my main triangles, in the manner that I would direct, and therefore communicated for the use in the Coast Survey.

Such a proposition on the part of the state, so nearly imbedded in the work of the Coast Survey, would evidently be of considerable economy for both parties, and could be made use of advantageously for the acceleration of the works; I shall therefore be glad if you will please to communicate to me your wish and direction in respect to it.

The state of Maryland having to provide instruments for their works, I also offered, if it should meet your approbation, to cede for their work, against cost price, two nine-inch theodolites from the Coast Survey collection, which in the present state of the work, are not needed, having been originally intended for the reconnoitering work, which is now carried on in a different manner, the amount to be received for them would be more advantageously applied for some other instrument actually needed for my work in the course of next summer.

The favor of your decision upon both these points, for my direction in respect to them, will oblige me.

I have the honor &c.
F. R. HASSLER.

Hon. R.B.Taney, Secretary of the Treasury of the U.S.

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GEOPHYSICAL EXPLORATION

Although the Coast and Geodetic Survey has never done any direct geophysical prospecting, some of its gravimetric and magnetic measurements have proved very useful in studies of underground geological structure, and the results have therefore frequently been of considerable economic importance. Because of this fact it was thought that readers of the Geodetic Letter would be interested in the following brief article which appears under the above heading in a pamphlet issued by the Gulf Research and Development Corporation.

It will be noted that the article states that the gravity apparatus "is essentially an exceedingly accurate clock". We believe that this statement should be qualified by stating that it differs from a clock in one important respect, namely, it has no driving mechanism. In the next paragraph it is stated that the torsion balance is an older field instrument than the gravity pendulum apparatus. Although it came into use later for geophysical exploration the gravity pendulum is certainly an older field instrument than is the torsion balance. Except for these minor criticisms the article is an excellent one in showing very briefly why the three methods discussed have been found useful for underground exploration.

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"Geophysical prospecting is a relatively new but important activity of a large oil corporation. Geophysics seeks, by the application of scientific principles, to accomplish the dreams and claims of the douser who used a forked stick to locate water, oil, gold, buried treasure or anything else of value hidden below the surface of the ground. The diviner walked across the ground, made certain mysterious motions, was secretive about just what caused his choice when he said "this is the spot", and told his client with perfect confidence that the desired material was directly underneath. Geophysical prospecting uses a crew of from a few to as many as fifty men with thousands of dollars worth of scientific equipment to make elaborate surveys and then says "conditions under this area appear to be favorable for an oil field". In general, one may be sure that the value of a scheme for finding things below the surface is inversely proportional to the secretiveness as to method and the certainty of success which is claimed by its proponent.

"Oil used to be found where it seeped out of the ground (the original Drake well of 1859 was drilled on Oil Creek, so named from many oil seeps). Later, geologists learned the prin-

ciples of oil accumulation and that a dome or anticline forms a trap or "structure" in the rocks within which the oil is imprisoned. Great areas were mapped to find the structures which made themselves evident by deformation of the surface rocks. But many good structures are buried beneath hundreds to thousands of feet of undisturbed rock laid down since the earth movements causing the structure were completed. Surface geological work gives no hint of their presence. It is the success in finding these buried structures that has made geophysics so important to the oil industry.

"Any conceivable physical property of the rocks of the earth's crust that could be measured at the surface through a cover of from hundreds to thousands of feet of sediments might be made the basis for a method of geophysical prospecting. Many schemes have been suggested and tried, but practically all present day methods of geophysical prospecting for oil are based on three fundamentally different physical properties of the rocks of the earth's crust. These are the magnetic, depending on differences in their state of magnetization, the gravitational, depending on differences in their density or specific weight, and the seismic, depending on differences in their rate of propagation of artificial earthquake waves.

"The gravitational method requires the measurement of very small differences in gravitational attraction. These differences are caused by irregularities in mass distribution which in turn are caused by warping or folding or rock layers of different density. By mapping the gravitational field to high precision, we may infer certain things about the nature and configuration of the rocks below the surface.

"One instrument used for measuring the gravitational field is a pendulum, which is essentially an exceedingly accurate clock, capable of measuring time to about one ten-thousandth of a second. The period of vibration of the pendulum is affected by the gravitational attraction of the earth including masses near the surface. By measuring very carefully the changes in the period of vibration from one locality to another, a map of the gravitational field can be constructed and from it the distribution of mass beneath the surface of the earth can be determined.

"An older and more common field instrument is the torsion balance. This very sensitive instrument measures the gradient or rate of change of the force of gravity. Knowing the rates of change at numerous places, one can calculate the mass distribution beneath the surface and thus infer the presence of oil structures as in the case of the pendulum. This instrument is so sensitive that the gravitational attraction of a man standing nearby is easily recorded and yet the instrument is so well built that it can withstand transportation over the worst roads in existence.

"The magnetic method uses a "magnetometer" which measures small differences in the intensity of the earth's magnetic field. This field is influenced by rocks that are slightly magnetic, which include nearly all of the igneous or basement rocks lying below the sedimentary rocks within which oil is found. Careful magnetic measurements when properly interpreted will reveal the depth and configuration of the basement rocks to give a measure of the sedimentary thickness available for the accumulation of oil, and to give indications of basement topography which may cause favorable folding or "structure" in the overlying sedimentary rocks.

"The seismic method depends upon the propagation through the earth of artificially induced small earthquake waves. Careful measurement of the time of travel of these waves can be interpreted to reveal the depth and nature of the underlying rocks. In the "reflection" method the time for an echo from a deeply buried rock layer is measured and the depth of the reflecting layer calculated.

"A seismic field outfit is a veritable traveling laboratory. A truck contains intricate electrical apparatus, connected by long cables to a series of very sensitive seismic detectors distributed at various distances from the truck. Another connection, either by wire or radio is made with the point at which the explosion is set off. A photographic laboratory in the same truck enables the development of the record of each shot immediately after it is made.

"By careful reflection seismic exploration, it is often possible to make a map of the configuration of a rock layer many thousands of feet below the surface on which differences of elevation can be shown accurately to within a few feet. At the present time the reflection seismic method is the most actively used, there being well over 100 such parties in the field in this country."

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CHECK MARKS ON LISTS OF DIRECTIONS

Repeated efforts have been made to induce computers to prepare lists of directions carefully and neatly. The response to these pleas has been gratifying. An example of what may happen through carelessness is illustrated here. This mistake would have gone into the final publication of triangulation data had not the typesetter made another mistake which attracted the attention of the proof-reading mathematicians.

Figure 1

GEOGRAPHIC POSITIONS

Accession No. of Computation:

lity San Luis Obispo, Northeastward Datum North American 1927 State California

STATION	LATITUDE AND LONGITUDE	SECONDS IN METERS	AZIMUTH	BACK AZIMUTH	TO STATION	DISTANCE LOGARITHM (METERS)	DISTANCE METERS	DISTANCE FEET
en, 1932	35 24 02.943	90.71	129 16 40.88	309 13 49.63	Barren	3.9833346	9623.53	31573.2
d.m.	120 29 24.346	614.3	209 46 11.78	29 48 07.59	Grassy	4.0060322	10139.86	33267.2
			244 06 43.32	64 09 26.75	Highland	3.8980087	7906.95	25941.4
			295 11 45.11	115 19 26.55	San Jose	4.3475456	22261.05	73034.8
			25 14 05.38	205 11 38.20	San Luis	4.1785074	75083.68	49487.0

The distance in meters from station Green to station San Luis as given in Figure 1 is apparently 75,083.68 meters. The typesetter copied it as 7,508.68 meters (see Figure 2) as he also copied the distance 22,261.05 above as 2,226.051 which mistake attracted attention to these two numbers.

Figure 2

Green, 1932	35	24	02.943	129	16	40.88	309	13	49.63	Barren	3.9833346	9,623.53	31,573.2
	120	29	24.346	209	46	11.78	29	48	07.59	Grassy	4.0060322	10,139.86	33,267.2
				244	00	43.32	64	09	26.75	Highland	3.8980087	7,906.95	25,941.4
				295	11	45.11	115	19	26.55	San Jose	4.3475456	2,226.051	73,034.8
				25	14	05.38	205	11	38.20	San Luis	4.1785074	7,508.68	49,487.0

Looking up the antilog of 4.1785074 it was found that the distance from Green to San Luis should be 15,083 meters. The horizontal bar of the apparent 7 was a check mark for the preceding logarithm, which, when photographed seemed to combine with the digit "one" to form the digit "seven". The point should be obvious.

It is again requested that all check marks be made with blue pencil for the reason that blue will not photograph and there is therefore, less danger of confused figures such as shown above, when the table is photostated or otherwise photographed.

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USE OF AERIAL PHOTOGRAPHS ON BOUNDARY SURVEYS

The Chief, Technical Commission for the demarcation of the boundary line between Guatemala and Honduras, Mr. Sidney H. Birdseye, states that the aerial photographs and maps from which the boundary line was selected and described, have saved one or more years of work and have permitted the accurate mapping of the frontier zone at a very nominal cost.

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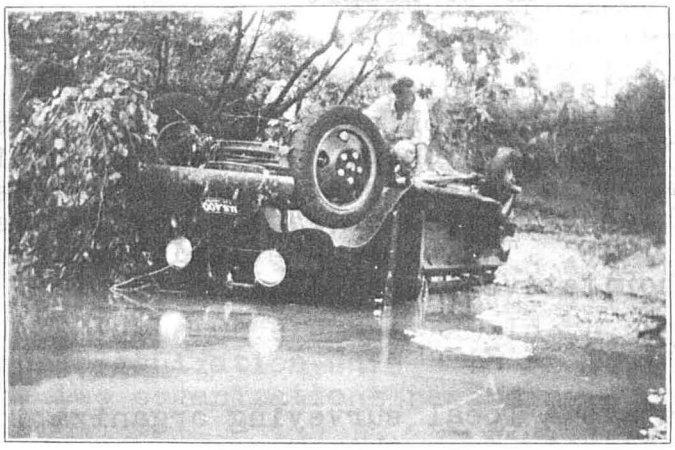
ANOTHER ONE OF THOSE THINGS



Near Cadiz, Ky. - The result of a sudden freshet (10 foot wall of water) racing down a dry creek bed where three Coast Survey trucks were stuck. While one of the drivers went in search of mules the other members of the party heard the rushing of the water and succeeded in anchoring two of the trucks to trees on the bank before the water reached them. The third truck was overturned by the force of the water and floated 200 yards down the creek where it lodged against a tree.

REPLACEMENT OF SURVEYING MONUMENTS

H. W. Hemple

(This article amplifies the discussion in regard to Question 2a - "In the case of occupation of stations marked by other organizations; should the station be remarked if not in good condition or should a new mark be established and a tie made to the other station?" which was given on Page 27 of the Geodetic Letter for November, 1935. The procedure indicated herein, should be considered authoritative practice. --Editor.)

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Several years ago a local surveying organization, without receiving prior authority from this Bureau, remarked a number of Coast and Geodetic Survey first-order triangulation stations and placed their own type of discs on the monuments. Many of these marks had been established in the early days of the Coast Survey, but they were all in good condition and there was no excuse for their being remarked at that time. This Bureau protested very strongly against this remarking, and legitimately so.

During the past few years it has come to the attention of this office that some of our own triangulation parties are replacing monuments of other organizations with new monuments in which our standard discs are placed. Even though the new mark may be placed in the exact position of the original monument there will always be a question in the minds of subsequent users as to the exactness of the replacements. Should a local engineer or surveyor have only the description of the original mark, he may not know that it has been replaced with our monument and may conclude that the original station is lost. This is apt to be particularly confusing if an attempt is to be made to rerun surveys based on the original station mark. Considerable embarrassment may be caused this Bureau as a consequence.

In 1928, the Federal Board of Surveys and Maps adopted a report of which the following excerpt is pertinent to this discussion:

> "Where a station of third-order or higher accuracy, originally established by another organization, is definitely recovered, but is found to be inadequately marked, it should be remarked in a permanent manner, and the character of the new mark described in the recovery note. If the station was originally marked by a tablet, the tablet should be reset

in the new mark. If the station was not marked by a tablet, then a tablet such as is now used by the organization which established the station should be secured by the field party from its own headquarters and used as the new station mark. If there is not time to secure the tablet, a copper bolt may be stamped with the initials of the organization which first established the mark, and this bolt should be used as the station mark. If the original station cannot be exactly recovered or if, for any reason, it is not desirable to re-occupy it, a new station may be established near by and marked, and the old station should be connected with the new one and used as a reference mark for it. In general, no survey monument established by one organization of the Government should be changed or replaced by another organization unless there is an agreement between the two organizations regarding such replacement.

"However, a station established by another organization should never be remarked unless it had a subsurface mark and this was definitely recovered or unless the tablet was established in rock and its original location can be definitely and accurately determined. The recovery note should describe the present condition of the surface, subsurface, and reference marks in sufficient detail to make the record clear as to the certainty of recovery of the station."

Where it is impossible to remark a station in accordance with the above recommendations, a new station marked with our standard discs should be established in close proximity and a direction and distance measured to the mark of the other organization. The original mark should not lose its identity, unless there is a prior agreement between the two organizations concerned.

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CONCERNING "CONSTRUCTIVE CRITICISM"

Charles J. Clifford

The September-October issue of Geodetic Letter has an article entitled "Constructive Criticism" by Andrew L. Breckenridge who recovered and stamped bench marks in Connecticut and Rhode Island for the Coast and Geodetic Survey during the winter of 1934-35. This Bureau always appreciates suggestions looking toward the improvement of its service to the public. At the same time, it should be pointed out that the standardized procedure which has been adopted must appear at times to overlook certain local conditions.

In this article Mr. Breckenridge summarized criticisms and suggestions which he received from engineers with whom he came in contact. Some of the criticisms are justified and some are not, but in many cases both the criticisms and suggested remedies are viewed wholly from a local standpoint, and the fact is overlooked that, in planning a program of field work and of publication, the country must be considered as a whole, and this may result sometimes in a conflict with local conditions.

> "A bench mark is useful only as long as it is recoverable. When changes occur, as they often do, in the surrounding natural and cultural features with relation to which the mark is described, it becomes increasingly difficult to find the mark by means of the published description. Engineers and others who have occasion to visit any bench marks established by this Bureau, or other Government organizations will be doing a public service if they will report the condition of the marks and make suggestions as to needed changes in the descriptions."

All recent leveling publications of this Bureau contain the three sentences quoted above. They serve to emphasize the dependence which must be placed upon the cooperation of the public in keeping description files up to date. It is impractical to make a complete field check of the descriptions of bench marks in a state before preparing them for publication. Not only are time and funds lacking, but there is the added drawback that in large states having from 4,000 to 6,000 marks, the field check itself might be partially obsolete before it was completed. Such being the case, the most satisfactory method of securing reports has been found to be the one now in use. Descriptions and elevations of bench marks on each line of leveling are published in small editions of "ditto" or mimeographed lists. When requests for information are received, these lists are sent out together with a supply of the form, "Report on Condition of Bench Marks". Results have been very gratifying, although a very considerable number of the forms are never returned.

With especial reference to Connecticut and Rhode Island, it was stated in the above article that some of the information in Special Publication No. 181 was obsolete before it was published. This is perfectly true, and it was realized at the time of preparing the manuscript that many of the descriptions would not fit present conditions, but since up-to-date information was lacking it was necessary to use the descriptions we had on file. A glance at the publication will show that the greater part of the leveling in Connecticut and Rhode Island was done in 1922 and 1923, although in Connecticut one short line

was run in 1916 and various others were run between 1925 and 1932 by the Columbia Summer School of Surveying. Prior to the issuance of the publication early in 1934, engineers not in the government service had sent in only 63 reports on condition of bench marks for Connecticut and 16 for Rhode Island. Reports had been received from the U. S. Geological Survey in 1924 for a part of the lines in Connecticut and they were used in the revision of the descriptions, but changes during the following ten years could easily have rendered the descriptions untrustworthy.

Reports stating that marks are destroyed would not be ignored in the preparation of publications if the persons making the reports would give some definite reason for making the statement. Merely saying that a mark could not be found and that it is recommended that it be marked "Destroyed" is not sufficient evidence to designate it as "Destroyed" in the records of this Bureau. The suggestion that engineers be notified when a mark reported by them as destroyed is later recovered, is not quite practical. Although it would be a friendly gesture, it would involve a large amount of correspondence which could possibly become unduly burdensome.

With regard to the complaint that "published elevations of many of the old bench marks marked with the U.S.C. & G.S. and U.S.G.S. disks have never been republished in agreement with the 1929 General Adjustment", this Bureau has never published the results of the Geological Survey leveling in either Connecticut or Rhode Island. The only Coast and Geodetic Survey marks in those states which were omitted from Special Publication No. 181 were tidal bench marks which were not connected to the geodetic level lines. Tidal bench marks are made the subject of separate publications.

Special marking of bench marks by states or otherwise, while commendable, has never been undertaken by this Bureau, although a few state organizations have so marked our bench marks within their particular jurisdiction.

In the office revision of descriptions, the reports of the United States Geographic Board are used with regard to the choice of names and their spelling. Also a standardized list of descriptive terms is used, but it is sometimes difficult to determine what is meant by the original description. The word "pier" for example, sometimes means pier in the description but very often means abutment.

The use of township names instead of counties is again a purely local problem. Outside of New England only a few states consider the township of more importance than the county. For this reason, the county has been adopted as the smallest division used in descriptions.

TRIANGULATION GOING NATIVE

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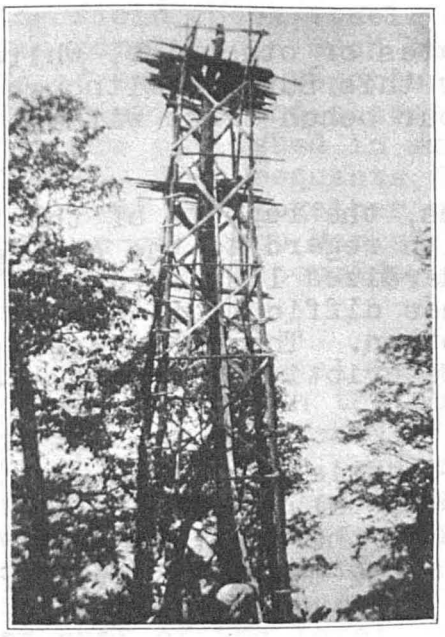
Above is shown the beginning of a 60 foot tower on Pine Mountain, Near Logan, W.Va., where a standing tree trunk was used for the tripod. Until the tower was completed, the light was shown from the board nailed across the top, the lightkeeper perching on the limb about 10 feet below.



The completed tower built entirely of native poles. As the poles were short and crooked, it was necessary to splice them 3 and 4 times in order to get the required 60 feet of height. The tripod (a standing tree trunk) was braced with split rails which were bowed to give greater rigidity.

This station was occupied with a 9-inch direction theodolite and in spite of a strong wind, 16 positions were taken on 7 lights without a rejection, the usual 5-second run of this particular instrument being maintained.

GEODETIC CONTROL FOR CADASTRAL SURVEYS

Hugh C. Mitchell

The May, 1935 number of Geodetic Letter was devoted wholly to a symposium on the use of geodetic control for cadastral surveys. From the correspondence which resulted from the wide distribution of that number, the following pertinent excerpts have been selected for publication. As each of these statements is complete in itself, it is believed that not the slightest misinterpretation can result from not publishing the letters in their entirety. It is hoped, however, that the letters as a whole may be published in a future number of the Geodetic Letter which will be devoted largely, if not entirely, to this important subject.

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From a letter received from Mr. E. H. Owens, of Kansas City, Missouri, an engineer with wide experience in surveying in and around a large city, the following has been taken:

"In your letter of July 6, 1935, you ask; 'If you have a direct tie from one of your triangulation stations to a recognized section corner ... corner becomes lost ... who do you believe would come nearer to reproducing original position ... you ... or another surveyor of equal ability working according to ... rules ... General Land Office ... and which of you would win in a Court decision?'

"This is of course problematical. It might be said that I also know the rules of the General Land Office and the Triangulation Information is additional and exclusive information. If it was given preference over a relocation according to General Land Office rules, it would be because the court classed it as local evidence, which takes precedence over admeasurement. I would like to amplify this by a concrete illustration.

"A corner of the public land survey becomes more or less lost . That is, the marker is gone. It was known to be about in the center of the crossroads and witnesses will testify to that fact. The original Land Office survey, as usual, was inaccurate. A proportional remeasurement to nearest corners would place the corner entirely outside the crossroads or at least ten feet from known position according to all witnesses. I believe the triangulation tie, which substantially agrees with testimony would satisfy the owners in 999 cases out of 1000 without suit and would win in the suit in the other case. It should properly be put in the class of measurements to witness trees, which were sometimes erroneous, but which will prevail over admeasurement from distant corners if confirmed approximately by testimony.

"With reference to use of streets for survey work, I have never met with any objection; in fact, the public seems over-generous to surveyors where proper warning is given. Even with legal authority it would be necessary to give reasonable warning to fast traffic. I have never hesitated to temporarily halt traffic to measure across streets in a reasonable length of time and frequently use a car as a barrier in traffic to protect an instrument and have never been arrested for blocking traffic. If legal authority were asked, a bond would probably be required as the city, having granted permission, would be jointly liable."

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Acknowledging receipt of the special number of the Geodetic Letter to which reference is made above, Mr. W. D. Jones, of Chicago, well-known in Illinois and neighboring states as an authority on land surveying and particularly on the practices of the General Land Office, writes as follows:

"I have no doubt that in the original 13 states and in Kentucky, Tennessee and Texas where the descriptions of boundary lines are by metes and bounds, your suggestion for new descriptions based upon coordinates of the U. S. Coast and Geodetic Survey would be of material benefit in descriptions of private property and of boundary lines in general. It may be a serious legal question as to whether the laws you suggest will be enforceable for, as I understand the law, a description of any boundary line which would change the location thereof, as the same was created by the original monuments, would not be a good law as neither the State nor the United States can take any man's land without due compensation and to change his boundary line might have the effect of taking some of his land. Of course, adjoining owners can in fact change the location of their boundary by agreeing that the same is located in a certain place, whether or not they know they have changed the said boundary from its original location. Therefore, I suppose that if the owners acquiesce in the location of the boundaries as fixed by this system of coordinate descriptions, they will in time be bound by them.

"Just how simple your proposed descriptions would be I do not know, but I feel very certain that they cannot be any more simple than are our descriptions of land in the U. S. where the sectional survey system is in use, which is practically all of the U. S. except the original 13 states, Kentucky, Tennessee and Texas; and even parts of some of these states have the sectional survey system or something that amounts to the same thing. It seems to me that our sectional survey system is itself a system of coordinates. There are no overlaps or gaps unless by error and/or lack of knowledge as to the location of the section lines.

"In Niles Weekly Register published at Baltimore July 24, 1819, I find an article, signed J. Meigs, general land office, June 29, 1819, telling about the absolute perfections of our Sectional Survey System, in which he states 'This wise system takes away all temptation to incur the curse pronounced by Moses on him "who removeth his neighbor's landmark". The landmark is indeed immovable; for, though the marked trees at any one corner may be burnt or destroyed yet at the distance of half a mile east, west, north or south, there are other marked trees by which the true corner may be found'. Experience has shown that Mr. Meigs was grossly in error in making this statement, however, that was not on account of any fault in the system (if there had been trees to mark at every half mile) but because the original surveys were not accurately executed. However, the system with all its imperfections is so much better than any existing elsewhere in the world, and there are so many advantages to the simple and few words that we need to use, to describe any fractional part of a section any place in the U. S. that it seems to me it would be a crime to abandon the system.

"This does not mean that we could not gain help in preserving the location of our section corners, by tying in the location to any monuments made available by the U. S. Coast and Geodetic Survey Department. This I think is an objective toward which we should direct our efforts; that is, preserving the locations of the section corners by tying to any monuments made available or to any system of surveys made with the care taken by the U. S. Coast and Geodetic Survey Department. While many of our acts help us in preserving the location of our monuments we are at the same time very certain that many of our acts carelessly destroy the actual physical monuments which are so very important to us; especially so in connection with the construction of our comparatively new system of concrete highways.

"As to the suggested act to give the right to any qualified or licensed surveyor in the practice of his profession to enter private property for the purpose of finding monuments subject to the paying of any damages he may cause, I think that would be a wonderful law but I see no reason why it should be confined to the finding of the monument placed by the U. S. Coast and Geodetic Survey; and as to the destruction of monuments there is already an Illinois and a U. S. Statute providing for a fine and imprisonment for 6 months to one year for any one who wilfully and maliciously injures or removes any such monument."

To Mr. Jones' letter the following reply (in part) was made:

"I would use it (your letter) to illustrate the fact that you and I are in complete agreement in the matter recognizing the simplicity and permanent value of the General Land Office method

of describing property. It has never been in my mind that it should be discarded; nor has it ever occurred to me that any engineer could, by geodetic methods, recover or re-establish a corner of a public land survey unless that corner had previously been tied into a geodetic control net, and its coordinates on that system known.

"The General Land Office itself recognized this value of geodetic control surveys, and for several years triangulation parties of this Bureau operating in public land states were accompanied by cadastral engineers from the General Land Office, whose mission it was to recover and identify marks of the land survey so that the geodetic engineer could tie them into his triangulation.

"What I have seen and read of Land Office surveys thoroughly convinces me that it takes an exceptionally well trained man - a specialist in his field - to recover or restore the marks of those surveys. This makes it all the more desirable, so it seems to me, to give complete protection to such marks, often recovered as they are at a considerable expenditure of time and effort (both of which cost money), and such protection can be given by connecting those marks to the national control survey, and determining their positions on the datum thereof.

"However, it is no longer necessary for the engineer to use geodetic formulas and make geodetic computations in utilizing the national control survey for referencing and controlling his local property surveys. This is now a fairly simple operation, provided stations of the national control survey are at hand (as they eventually will be), since in a very little while there will be available coordinates of all triangulation stations on state-wide plane rectangular coordinate systems, and the engineer may continue to use the methods of plane surveying, yet secure the advantages of accuracy and permanency which come from basing his surveys on the national triangulation net . . ."

If asked to single out from the foregoing a paragraph to receive special emphasis, I would unhesitatingly select the one in which it is stated that no engineer could, by geodetic methods, recover or re-establish a corner of a public land survey, unless that corner had previously been tied into a geodetic control net and its coordinates on that system were known. This statement may be made even stronger by saying that when such connection has been made and the position of the corner is known on a geodetic datum, then its position on the ground can be reproduced by a competent surveyor by reference to recoverable stations of the control net. And it may be quite evident that if the geodetic datum used is the one on which the national triangulation survey is based, then the land corner can never be truly lost, as it is inconceivable that more than a very small percentage of the stations of that net will ever be completely destroyed.

Furthermore, (and this is most important from a practical standpoint), since the positions of stations of the national triangulation net are now being made available in the form of coordinates on state-wide plane coordinate systems, any surveyor who desires to make use of this very valuable feature of the national triangulation may do so without having any training or experience as a geodetic engineer, since he may carry on all desired operations and secure satisfactory results through the use of the methods and formulas of plane surveying.

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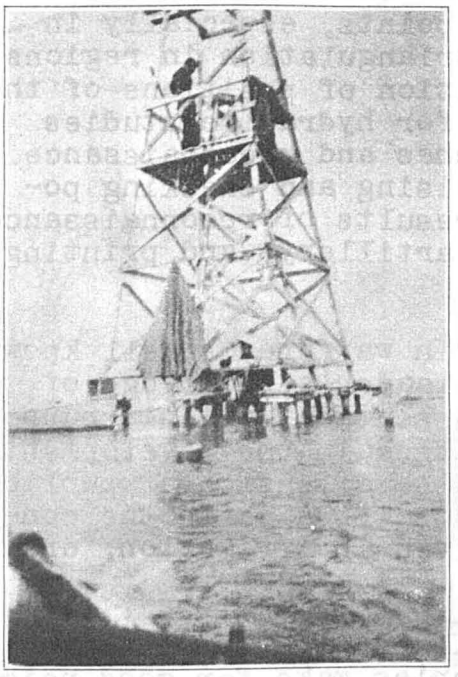

STATION UNDER WATER

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Triangulation station Middle Shoal - Key West Arc. Station mark under water at all times.

To collimate, it was necessary to make form to put over mark and pump water out in order to get plumb bob over center of disc.

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KNOWLEDGE OF TOPOGRAPHY

A knowledge of topography is essential in the modern conduct of war, according to Prof. Roberto Muller of Argentina, in his recent article "Importancia de la Tecnica Topografica en la Moderna Conduccion de la Guerra", which appeared in the Revista Militar for July, 1935. The topographic branch is an extremely important part of the Geographic Service of War of his country. In the artillery where accurate firing is essential, the map is called the vertebra of the artillery.

An outline of the daily work of the Service includes increasing the density of trigonometric points, especially in zones of intense artillery activity; triangulation in regions of fundamental public works; determination of positions of the various pieces of artillery; leveling for hydraulic studies and for elevations of positions; sketches and reconnaissance for accurate tactics; aerial maps; revising and checking positions of existing maps; publishing results of reconnaissance and aerial surveys; making charts for artillery; and printing of charts and maps.

The value of accurate elevations in warfare is well known. Many a battle has been decided by the leader's knowledge of the terrain. The topographic map is essential for this purpose. Not only is it an aid in warfare, but also in the development of natural resources of all kinds, in the extension of public works, in the building of highways and railroads, in the construction works of various kinds involved in irrigation, drainage, flood control, etc.

In the perpetuation of boundary lines, the topographic map plays a leading role. Good boundaries make for good neighbors and peace is the result.

With good maps it is easy to arrange campaigns, expeditions and exploration work. Accurate artillery fire can be planned and executed with greater precision with a knowledge of the terrain. In reconnaissance work and determination of positions for certain types of combat, aerial photography is invaluable, and the topographic map is the basis for the photo-topographic map.

The principal classes of work necessary for artillery work in the Geographic Service of War are triangulation of first and second order, additional determinations of important points, elevations for civil and military works, and magnetic determinations for correction of azimuth compasses and magnetic surveys.

The map is constantly being changed and revised as new public works, railroads, highways, farm areas and river changes are added to it. Maps are not only indispensable in war but also in peace. The Geographic Service of War is an aid to both civil and military engineers - it is invaluable in training personnel for defense of the nation during war and for developing natural resources during peace.

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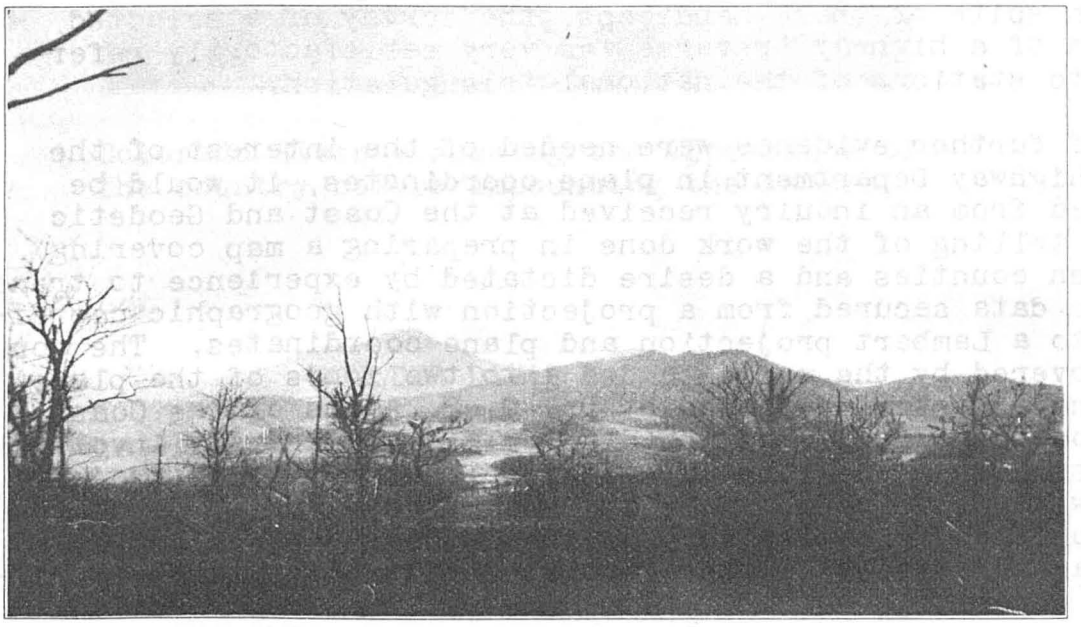

Looking northwest towards the Smokies from the end of the Appalachian Trail on Mount Oglethorpe, near Atlanta, Ga.

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GEODETIC CONTROL FOR TEXAS HIGHWAY SURVEYS

(From the Military Engineer for November-December, 1935.)

A very interesting test of the use of geodetic control in highway surveys has been made during the past summer in the southern part of Texas. Fully convinced of the economic advantages of controlling highway traverses and maps by reference to the national control survey, the Senior United States Highway Engineer and the Division Engineer of the Texas Highway Department arranged to connect the survey of a highway across Kenedy County to stations of the 98th meridian triangulation.

In many ways this was pioneer work. It was executed under considerable difficulty. In the computation of grid positions on the plane coordinate system recently devised for that portion of the State by the Coast and Geodetic Survey, considerable difficulty was encountered in securing the proper logarithmic tables for the work. Even in making studies of computational methods and formulas involved, the manual for such purposes which had been prepared by the Coast and Geodetic Survey was so new that an advance copy in the form of a page proof had to be sent for guidance.

In spite of these handicaps, the survey of a selected section of a highway traverse was very satisfactorily referenced to stations of the national triangulation.

If further evidence were needed of the interest of the Texas Highway Department in plane coordinates, it would be obtained from an inquiry received at the Coast and Geodetic Survey telling of the work done in preparing a map covering some ten counties and a desire dictated by experience to transfer the data secured from a projection with geographic coordinates to a Lambert projection and plane coordinates. The counties covered by the map extended into two zones of the plane coordinate system developed by Dr. O. S. Adams of the Coast and Geodetic Survey, but the difficulties ordinarily involved in passing from one zone or system to another in map projections will prove no obstacle in such cases as this, since the transposition is easily made on the Lambert projection, even where an adjustment is made involving control stations in different zones.

A further and conclusive evidence of the appreciation in Texas of the value of well-controlled highway surveys is had from a request for information as to the standard way used by the Coast and Geodetic Survey in monumenting its survey stations. Such a request is but a corollary to the others, for a full appreciation of the value and uses of an accurate and well-controlled survey surely involves having such surveys monumented in as permanent a manner as is possible with a reasonable expenditure for concrete monuments and metal tablets.

The Texas Highway Department is doing a splendid piece of engineering in its studies looking to the establishment of well-controlled and permanently-monumented highway surveys, and there is every reason to hope that other states will follow this example. Such surveys will have many uses and pay for themselves many times over.

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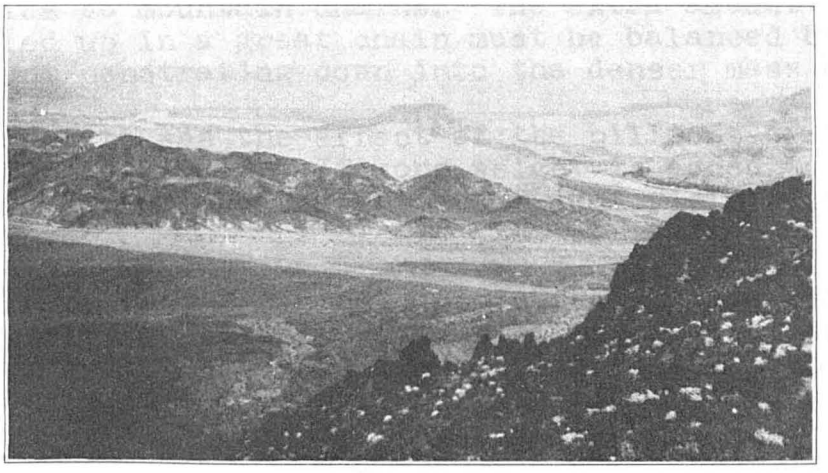

Colorado River - showing the appearance of the country before impounding the waters.

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BOULDER DAM'S WATERS

(Reprinted from the New York Times, August 4, 1935.)

Eventually 41,500,000,000 tons of water will be impounded to form a hugh lake behind Boulder Dam. The weight may bend the earth's crust. By how much?

Already the Unites States Coast and Geodetic Survey is preparing itself to answer the question. Bench marks are to be carefully placed over the area which is to settle. Measurements will be made. When the reservoir is filled new leveling will be established. By comparing the results of the two determinations the amount of settling will become known.

The surface of the earth as we know it consists of granite layers that float on heavy, sticky material below, much as an iceberg floats in water. This view has made it necessary to create a special branch of geology called isostasy.

According to the theory of isostasy, wherever equilibrium exists on the earth's surface equal masses underlie equal surface areas. Thus a huge granitic mass with an average surface elevation three miles above the mean depth of the oceans must be lighter than the material of the ocean floors. Moreover, in order to compensate for its greater mean height this lighter material must extend downward to some distance under the continent and below the ocean floor so that unit areas beneath oceans and continents may remain in stable equilibrium. The same rea-

soning applies to mountain chains. The extra amount of lighter material piled up in a great chain must be balanced by a proportionate amount penetrating down into the denser mass beneath.

It is easy to see the effect of the billions of tons of water in Boulder Reservoir. If more weight is added to that which nature placed at Boulder Dam the crust must yield until equilibrium is restored.

No ordinary weight can have any effect on a crust supposed to be from twelve to seventy-five miles thick. But this is an extraordinary weight - a weight which makes it possible to test the theory of isostasy directly for the first time.

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NOTES

In the October number of the Publications of the Astronomical Society of the Pacific is an interesting note by Dr. Hamilton M. Jeffers, on some latitude observations made at the Lick Observatory with a Bamberg transit which was loaned by the Coast and Geodetic Survey to the Observatory in 1933 for use in the International Longitude Campaign of that year. Latitude observations were made on six different nights with probable errors ranging from ± .04 to ± .09. The number of pairs observed on each night varied from 7 to 14.

It is interesting to note that the computations of the latitudes were based on the new Albany General Catalogue. This catalogue has not yet been published but Dr. Jeffers was able to obtain the positions of the stars he used by correspondence with the Albany Observatory. The small probable errors obtained by Dr. Jeffers not only showed very accurate observing but they also indicate that the star places are excellent. As soon as this new catalogue has been published the Coast and Geodetic Survey intends to use it for its latitude work. In the meantime we are still using the Boss Catalogue although better star places undoubtedly are available in some of the modern catalogues.

It has been thought advisable to keep all of the latitude results on the same basis until the change could be made to the new Albany Catalogue. It is hoped that at that time, the previous results can be corrected to correspond with the better star places.

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The November 9, 1935, issue of "Nature" published in London, England, carried a very complimentary write up on a recent radio talk given by Prof. S. S. Steinberg, of the University of Maryland, on the subject of highways in the United States. Prof. Steinberg was formerly the State Representative of the U. S. Coast and Geodetic Survey in the State of Maryland.

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The Pan American Institute of Geography and History held its second assembly in Washington, D.C., the week of October 14-19, 1935.

Captain William Bowie, who is the Honorary President of the Institute, was appointed by the Secretary of State as one of the National Committee of the United States to cooperate with the Institute. One of the papers presented was entitled, "Importance of Geographical Maps" by Mr. Octavio Bustamante of Tacubaya, Mex., Assistant Director of the Pan American Institute, in which he stressed the need and importance of having good maps in the development and extension of the activities of a nation. The bulletin which published this paper, also contained an article by Captain Bowie entitled, "Working with Maps", a copy of the address given by him at the meeting of the South Carolina Society of Engineers on June 15, 1934.

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The Division of Surveying and Mapping of the American Society of Civil Engineers held two sessions in connection with the fall meeting of the Society at Birmingham, Ala., October 16-18, 1935.

In the absence of Dr. William Bowie, who has been chairman of the Division since its organization in 1926, Prof. Philip Kissam of Princeton University, presided at both sessions. The following paragraph about the meeting appears in Civil Engineering for November:-

"Morning and afternoon sessions on Thursday provided opportunity for some excellent engineering programs developed by the Division, six separate sessions in all. Notable among these were the double sessions of the Surveying and Mapping Division. An enthusiastic group utilized both morning and afternoon to the limit of time in discussing surveying in its practical application in the Tennessee Valley and in Alabama, Mississippi, and Louisiana."

The program in part is given below:

"Surveying and Mapping in the Tennessee Valley" - N. H. Sayford, Director, Engineering Service, Tennessee Valley Authority, Knoxville, Tenn.

"Permanent Value for Highway Surveys Through Geodetic Control" - J. C. Carpenter, Senior Highway Engineer, U. S. Bureau of Public Roads, Fort Worth, Tex.

"Local Control Surveys of the U. S. Coast and Geodetic Survey in Alabama" - J. A. C. Callan, Head Professor, Civil Engineering, Alabama Polytechnic Institute, Auburn, Ala.

"Locating the Southern Natural Gas Pipe Line by Aerial Maps" - N. R. McKay, Esq., Southern Natural Gas Corporation, Monroe, La.

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At the recent meeting of the National Academy of Sciences held at Charlottesville, Va., November 18-20, Captain William Bowie spoke on "The National Mapping Plan of the National Resources Board". He also gave an address at the Engineers Club of Baltimore on November 13, on "United States Coast and Geodetic Survey Helps to Map Nation".

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At the regular monthly meeting of the American Institute of Consulting Engineers held in New York City on November 6, 1935, the Secretary of the Council presented a letter from Dr. William Bowie dated October 1, 1935, in regard to surveying and mapping as a means for relieving unemployment. After due consideration it was decided to send the following resolution to the American Engineering Council:-

"WHEREAS, American Institute of Consulting Engineers has four objects, one of which is 'to increase the usefulness of the profession to the public at large,

WHEREAS, membership in the Institute is limited to Engineers who are engaged in Consulting Engineering work, it is

RESOLVED, that the Council of the Institute reiterates its endorsement of the purposes of The Temple Act, Public Law No. 498 of the 68th Congress which provides for the completion of a standard topographic map of the United States.

RESOLVED, that the expenditures of public funds for this work would be in the nature of an investment in durable goods because standard maps of the United States could be used for decades and probably for centuries in the public interest.

RESOLVED, The Council of the Institute requests American Engineering Council to bring this matter to the attention of appropriate governmental agencies."

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Little

REPORT OF PROGRESS

Triangulation:

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

First-order - - - - - - - - - - - - - - - - - -	65
Second-order - - - - - - - - - - - - - - - - - -	0

* Lineal miles of triangulation completed during November, 1935:

First-order - - - - - - - - - - - - - - - - - -	0
Second-order - - - - - - - - - - - - - - - - - -	0

Total miles of triangulation completed to November 30, 1935:

First-order - - - - - - - - - - - - - - - - - -	61,422
Second-order - - - - - - - - - - - - - - - - - -	5,527

* Most field work ceased in August due to lack of funds.

Levels:

Lineal miles of levels completed during October, 1935:

First-order - - - - - - - - - - - - - - - - - -	294
Second-order - - - - - - - - - - - - - - - - - -	118

Total miles of levels completed to October 31, 1935:

First-order - - - - - - - - - - - - - - - - - -	106,895
Second-order - - - - - - - - - - - - - - - - - -	154,923

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