

INCLUDING IN HIS SURVEY AT LEAST ONE STATION (PREFERABLY TWO OR MORE) OF THE FUNDAMENTAL CONTROL NET OF THE COUNTRY. ONE SUCH STATION, WITH ITS GIVEN RECTANGULAR COORDINATES REFERRED TO THE STANDARD SYSTEM, PROVIDES STARTING VALUES OF X AND Y TO INTRODUCE INTO THE LOCAL SURVEY. IF OTHER BASIC STATIONS CAN BE INCLUDED THEY WILL PROVIDE THE MEANS TO CHECK AND ADJUST THE LOCAL SURVEY MORE SAFELY AND RIGIDLY INTO PLACE. TYING TO ONLY ONE BASIC STATION MAY MAKE IT DIFFICULT TO OBTAIN AN INITIAL DIRECTION WHICH WILL ORIENT THE LOCAL SURVEY HARMONIOUSLY WITH THE STANDARD COORDINATE SYSTEM. MANY OF THE MORE RECENTLY ESTABLISHED TRIANGULATION STATIONS OF THE FIRST-ORDER NET HAVE BEEN PROVIDED WITH AUXILIARY AZIMUTH MARKS FROM WHICH A REFERENCE DIRECTION IN TERMS OF GRID AZIMUTH MAY BE OBTAINED. LACKING SUCH AN AZIMUTH MARK, AN INITIAL DIRECTION MAY BE OBTAINED BY REDUCING TO GRID AZIMUTH THE AZIMUTH OBTAINED FROM AN OBSERVATION ON POLARIS. THE REDUCTION IS NOT DIFFICULT, BUT THE OBSERVATION ITSELF MAY BE INCONVENIENT. IF TWO OR MORE BASIC STATIONS ARE INCLUDED IN THE SURVEY, THE GRID AZIMUTHS BETWEEN SUCH STATIONS PROVIDE THE BEST INITIAL DIRECTIONS, AND THEY ARE EASILY COMPUTED BY THE ORDINARY FORMULAS OF ANALYTIC GEOMETRY FROM THE GIVEN RECTANGULAR COORDINATES OF THE STATIONS.

THE "BOTHER" CONFRONTING AN ENGINEER IN USING A STATE SYSTEM AS THE REFERENCE DATUM FOR HIS SURVEY HAS NOW BEEN OUTLINED IN ITS FOUR PARTS. THESE RELATE TO SHAPE, SCALE, PLACE AND ORIENTATION, ALL FOUR BEING ADJUSTMENTS OF HIS SURVEY TO FIT OTHERS UPON THE PLANE OF THE PROJECTION. AFTER ATTENDING TO THESE PRELIMINARY STEPS, ANY ORDINARY SURVEY MAY BE CONDUCTED IN BOTH FIELD AND OFFICE BY THE USUAL METHODS OF SIMPLE PLANE SURVEYING, AND IT WILL BE BASED AT THE SAME TIME UPON STANDARD DATUM.

IN CONCLUSION, AND TO ANSWER THE ENGINEER WHO ASKS "WHY BOTHER---?", THESE NEXT REMARKS ARE SUBMITTED. IT WOULD BE A VERY DESIRABLE COORDINATION OF INFORMATION IF THE RESULTS OF ALL SURVEYS -- PRIVATE, STATE, AND FEDERAL -- COULD BE EXPRESSED IN COMMON TERMS. SMALL SURVEYS WOULD EXPAND INTO HARMONIOUS CONTACT WITH OTHERS ADJACENT TO THEM. THE RESULTS OF ONE SURVEY MADE FOR SOME SPECIFIC PURPOSE WOULD BE SUPPLEMENTED PERHAPS BY INFORMATION ALREADY AVAILABLE FROM PRECEDING SURVEYS MADE FOR OTHER PURPOSES. SUCCESSIVE SURVEYS OF THE SAME AREA WOULD NOT NEED TO REPEAT THE PREVIOUS WORK, OR POSSIBLY A NEW SURVEY MIGHT BE WHOLLY UNNECESSARY BECAUSE OF THE ACCUMULATION OF INFORMATION ALREADY AVAILABLE FOR THAT AREA, REFERRED IN AN ORDERLY MANNER TO A DATUM COMMON TO ALL SURVEYS.

IN CONTRAST TO THIS IDEAL OF COORDINATION AND COOPERATION IN EFFORT, THE ACTUAL SITUATION IS OFTEN SUCH AS TO BRING NO CREDIT TO THE ENGINEERING PROFESSION. DOES IT NOT FREQUENTLY HAPPEN THAT DIFFERENT SURVEYORS AT VARIOUS TIMES WORK OVER AND OVER AGAIN IN THE SAME AREA, EACH FOR SOME SEPARATE PURPOSE, ALL USING DIFFERENT KINDS OF REFERENCE SYSTEMS WITH DIFFERENT ORIGINS AND ORIENTATIONS? PLAINLY, IN THE RESULTS OF OUR SURVEYS WE DO NOT ALWAYS SPEAK TO ONE ANOTHER IN THE SAME LANGUAGE. WE SHOULD TAKE CARE LEST WE BUILD ANOTHER TOWER OF BABEL.

DISCUSSION

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RECTANGULAR COORDINATE SYSTEMS SUCH AS ARE DESCRIBED IN THE ACCOMPANYING PAPER HAVE, IN THE PAST FEW YEARS, BECOME REALITIES, AND ARE STEADILY SECURING MORE AND MORE FAVOR FROM ENGINEERS THROUGH USE, AND ENDORSEMENT OF STATE OFFICIALS THROUGH LEGISLATIVE ACTION. MR. WILSON HAS GIVEN A CLEAR PICTURE OF THE ELEMENTS INVOLVED IN THE USE OF STATIONS OF THE NATIONAL TRIANGULATION FOR THE CONTROL OF LOCAL SURVEYS, AND A GOOD ANALYSIS OF HOW THE PROBLEMS ORDINARILY PRESENTED IN SUCH USE HAVE BEEN SATISFACTORILY SOLVED BY THE U. S. COAST AND GEODETIC SURVEY THROUGH THE ESTABLISHMENT OF SYSTEMS OF PLANE COORDINATES FOR THE VARIOUS STATES. IT SHOULD BE EMPHASIZED, HOWEVER, THAT NO

OPERATIONS NEED BE PERFORMED IN FIELD OR OFFICE EXCEPT THOSE OF ORDINARY GOOD PLANE SURVEYING IN ORDER TO USE STATE COORDINATES. THE SYSTEMS WERE DESIGNED ESPECIALLY TO ENABLE THE SURVEYOR TO SECURE THE ADVANTAGES OF ACCURACY AND COORDINATION IN LOCAL SURVEYS WHICH RESULT FROM BASING THEM ON THE NATIONAL TRIANGULATION WITHOUT BOTHERING WITH GEODETIC COMPUTATIONS.

THE ENGINEER DESIRING TO USE A STATE COORDINATE SYSTEM AS A BASE FOR LOCAL SURVEYS, STARTS WITH THE X AND Y COORDINATES OF SUCH STATIONS OF THE NATIONAL TRIANGULATION NET AS MAY BE AVAILABLE IN THE AREA IN WHICH HE IS WORKING, AND FROM SUCH A START CARRIES AHEAD HIS LOCAL TRAVERSES IN THE ORDINARY WAY, MAKING HIS COMPUTATIONS BY STANDARD PLANE SURVEYING FORMULAS, AND CARING FOR THE DISTRIBUTION OF ERRORS IN THE USUAL MANNER.

THE ESSENTIAL DIFFERENCES BETWEEN THE OLD ORDER OF MAKING SUCH A SURVEY AND THE NEW ORDER ARE TWO: BY COORDINATING THE LOCAL SURVEY WITH THE NATIONAL SURVEY THROUGH THE MEDIUM OF A STATE COORDINATE SYSTEM, ALL STATIONS OF THE NATIONAL SURVEY ARE MADE REFERENCES TO THE POSITIONS OF THE LOCAL SURVEY STATION. THOSE STATIONS CAN THEREFORE, WHEN NECESSARY, BE REPRODUCED FROM STATIONS OF THE NATIONAL SURVEY. FURTHERMORE, WHERE SEVERAL STATIONS OF THE NATIONAL SURVEY ARE USED FOR THE CONTROL OF THE LOCAL SURVEY, A CORRELATION WITH THE NATIONAL SURVEY IS SECURED WHICH MAKES IT POSSIBLE TO SECURE A HIGHER DEGREE OF ACCURACY IN THE ADJUSTMENT OF THE LOCAL WORK.

THE SURVEYOR MAKING LOCAL SURVEYS IN SEVERAL PARTS OF A STATE THUS NOT ONLY SECURES COORDINATION AND CORRELATION WITH THE NATIONAL SURVEY, BUT SINCE HIS SURVEYS, THOUGH DISCONNECTED AMONG THEMSELVES, ARE ON THE SAME BASE, THEY ARE ACCURATELY INTER-RELATED, AND ONE LOCAL SURVEY MAY FURNISH REFERENCES TO ANOTHER SOMEWHAT REMOTE SURVEY.

IN 1936 THE FEDERAL BOARD OF SURVEYS AND MAPS GAVE OFFICIAL APPROVAL TO THE USE OF THE STATE COORDINATE SYSTEMS BY ITS MEMBER ORGANIZATIONS FOR SUCH SURVEYS AND MAPS AS DID NOT BY THEIR NATURE REQUIRE THE USE OF GEOGRAPHIC PROJECTIONS. EVEN WHERE THE WIDE EXTENT OF THE AREAS BEING SURVEYED REQUIRED THAT A GEOGRAPHIC BASE BE USED, AS IN SURVEYS MADE BY THE U. S. GEOLOGICAL SURVEY AND BY THE U. S. COAST AND GEODETIC SURVEY, IT WAS CONSIDERED DESIRABLE TO PLACE THE STATE COORDINATE GRIDS ON THE MAPS BY MEANS OF SUPPLEMENTARY MARKS.

IN TWO STATES, NEW JERSEY AND PENNSYLVANIA, THE STATE COORDINATE SYSTEMS HAVE BEEN GIVEN FORMAL APPROVAL BY SUITABLE LEGISLATION, AND IN SOME HALF-DOZEN OTHER STATES, SIMILAR LEGISLATION IS IN THE MAKING.

CITY OFFICIALS AND PRIVATE ENGINEERS TOO ARE STEADILY LOOKING TO THE USE OF THE STATE COORDINATE SYSTEMS TO IMPROVE THE QUALITY OF THEIR SURVEYS, AND TO VERY MATERIALLY INCREASE THE PERMANENCY OF THEIR SURVEY MARKS.

IN ITS PUBLICATIONS OF SURVEY DATA THE COAST AND GEODETIC SURVEY NOW INCLUDES THE STATE PLANE COORDINATES OF EVERY STATION FOR WHICH IT FURNISHES THE GEOGRAPHIC POSITION. ALREADY THREE SUCH STATE VOLUMES, FOR MINNESOTA, CALIFORNIA, AND TENNESSEE, HAVE BEEN PUBLISHED.

WHILE ALL ENGINEERS HAVING TO DO WITH THE MAKING OF SURVEYS FOR ANY PURPOSE WHATEVER WILL FIND MR. WILSON'S PAPER HIGHLY INTERESTING AND INFORMAT-IVE, THEY MUST REMEMBER THAT SHOULD THEIR PLANS CALL FOR THE USE OF THE STATE COORDINATE SYSTEM, THEY MAY START WITH THE X AND Y COORDINATES OF THE CONTROL STATIONS, AND IN NO WAY BE BOTHERED WITH THE PROBLEM OF HOW THESE PLANE COORDINATES WERE EVOLVED FROM THE LATITUDES AND LONGITUDES WHICH REPRESENT THEIR POSITIONS ON THE NATIONAL DATUM.