OF AREAS OF THE VARIOUS CLASSES - SHOWN ON THE FIELD SHEET; BY COLORED CRAYONS OR BY CLASS NUMBERS OR BOTH - WERE TRACED WITH A SHARP STYLUS WHICH CUT NEARLY THROUGH THE CELLULOID. IF HELD AT AN ACUTE ANGLE THE STYLUS MADE A GROOVE WITHOUT REMOVING SHAVINGS. THE CLASS NUMBER WAS SCRATCHED IN THE AREA. WHEN ALL THE BOUNDARIES HAD BEEN TRACED IN THIS WAY THE SHEETS WERE BROKEN DOWN. DEEPLY CUT BY THE STYLUS, THE PIECES BROKE READILY UNDER SLIGHT BENDING.

INDIVIDUAL FIELDS OF ALFALFA, FOR INSTANCE, NUMBERED "2" WERE PLACED IN THE "No. 2" COMPARTMENT OF A 12-CUP PAN. THESE SMALL PIECES WERE WEIGHED ON A SET OF ACCURATE BALANCES. A TEST BLOCK WAS CUT FROM SOME PART OF THE SHEET NOT COVERED BY MAPPED AREA, THE WEIGHT OF WHICH BECAME THE CRITERION FOR THE WEIGHTS OF THE SMALL PIECES OF CELLULOID IN THE 12 COMPARTMENTS.

A DIRECT CHECK ON THE WEIGHING AND THUS ON THE SUMMATION OF AREAS WAS MADE FOR EACH FIELD SHEET. BEFORE BEING DIVIDED, THE PIECE OF CELLULOID COVERING THE FIELD SHEET WAS CAREFULLY WEIGHED. WHEN ALL THE AREAS AND THE TEST BLOCK HAD BEEN BROKEN OUT THE FRAGMENTS REMAINING ALSO WERE CAREFULLY WEIGHED.

THE SUM OF THE WEIGHTS OF SCRAPS, PLUS THE GROUP-PIECES, PLUS THE TEST BLOCK, HAD TO EQUAL THE WEIGHT OF THE ORIGINAL PIECE OF CELLULOID. A TOLERANCE OF ONE PART IN 1,000 WAS ADOPTED. IF THE LACK OF AGREEMENT EXCEEDED THAT RATIO, WEIGHINGS WERE REPEATED UNTIL THE DISCREPANCY WAS FOUND.

THE "DOUBLE SHEET" METHOD

WHERE THE FARMS WERE IRREGULAR IN SHAPE, THE DOUBLE SHEET METHOD WAS USED. THE TYPE CLASSES WERE OUTLINED ON TRACING CLOTH LAID OVER THE FIELD MAP, AND THE TRACING STAPLED SECURELY BETWEEN TWO PIECES OF CELLULOID, EACH OF NOMINAL 0.0075 INCH THICKNESS. STAPLES WERE SET EVERY 3/4 INCH COMPLETELY AROUND THE OUTSIDE OF THE MAPPED AREA.

THIS WHOLE ASSEMBLY WAS THEN CAREFULLY WEIGHED AND RECORDED. THE BLOCKS WERE CUT OUT OF THE ASSEMBLY WITH SMALL SCISSORS. AS EACH LOCAL AREA WAS CUT OUT, THE OPPOSITE PIECES OF CELLULOID WERE DROPPED INTO THEIR PROPER COMPARTMENT AND THE PIECE OF TRACING LINEN WAS ENCLOSED IN A SMALL ENVELOPE. WHEN THE MAPPED AREA HAD ALL BEEN CUT APART, THE SUM OF THE WEIGHTS FOR THE CLASSIFIED AREAS PLUS THE WEIGHTS OF THE SCRAPS AND THE TEST BLOCKS (ONE FROM EACH SIDE THE ASSEMBLY) PLUS THE REMAINING PIECES OF TRACING LINEN, HAD TO EQUAL (APPROXIMATELY) THE WEIGHT OF THE WHOLE ASSEMBLY BEFORE THE CUTTING COMMENCED.

THE BUREAU OF AGRICULTURAL ENGINEERING STATES THAT THE METHOD OF DETERMINING AREAS BY WEIGHING CELLULOID IS RAPID, NON-FATIGUING AND PARTICULARLY ADAPTED TO LAND-USE CLASSIFICATION.

MAPPING TEXAS

BY

RALPH J. McMAHON
TEXAS STATE RECLAMATION ENGINEER

REPRINTED FROM "THE TEXAS ENGINEER"

THERE ARE MANY SECTIONS OF TEXAS WHICH HAVE NEVER BEEN FULLY MAPPED AND THERE ARE NUMEROUS OTHER SECTIONS WHICH HAVEN'T BEEN MAPPED SINCE THE DAYS WHEN THE SURVEYORS, WITH CRUDE INSTRUMENTS, TOOK THEIR SIGHTS ON GIANT TREES WHICH ARE NO LONGER WITH US.

IT IS SAFE TO SAY THAT THERE IS NOT IN EXISTENCE TODAY A COMPLETE AND ACCURATE BASE MAP OF TEXAS. A BASE MAP IS THE MAP ON WHICH ALL OTHER MAPS ARE BUILT OR BASED. AN ACCURATE BASE MAP OF TEXAS WOULD BE INVALUABLE TO THE STATE AND TO ITS NUMEROUS POLITICAL SUB-DIVISIONS, AND MANY SERIOUS PROBLEMS NOW CONFRONTING THE STATE COULD EASILY BE SOLVED THROUGH SUCH A MAP.

THE PREPARATION OF SUCH A MAP WOULD HAVE BEEN A GIGANTIC UNDERTAKING A FEW YEARS AGO. BUT SCIENCE HAS MADE RAPID STRIDES IN THE LAST FEW YEARS AND IF THE FUNDS WERE AVAILABLE A BASE MAP OF THE ENTIRE STATE COULD BE PREPARED IN A COMPARATIVELY SHORT TIME THROUGH UTILIZATION OF THE AERIAL SURVEY.

THIS METHOD OF MAPPING HAS PROVED A SATISFACTORY SUBSTITUTE FOR THE

SLOWER AND MORE EXPENSIVE GROUND SURVEY. BESIDES FURNISHING NECESSARY DATA FOR BASE MAP OPERATIONS, AN AERIAL MAP OF THE STATE OF TEXAS WOULD BE INVALUABLE IN DETERMINING THE MOST PROFITABLE LAND-USE AND THE BEST METHODS OF RESTORING AND REBUILDING DAMAGED FIELDS AND PASTURES.

THE AERIAL PHOTOGRAPHS WOULD ALSO GIVE THE SOIL EXPERT A MORE COMPLETE PICTURE OF ANY PARTICULAR AREA THAN HE COULD OBTAIN EVEN BY TRAMPING OVER THE GROUND IN PERSON, AND FROM SUCH PICTURES COULD BE OBSERVED THE DIFFERENT SOIL TYPES, AND DETERMINED THE GULLIES WHICH CAN BE CROSSED WITH TILLAGE IMPLEMENTS AND THOSE WHICH ARE SO DEEP AS TO REQUIRE FILLING.

KNOWING THAT THE THREE MAJOR LAND-USES ARE ARABLE FARMLAND, PASTURELAND AND WOODLAND, LET US LOOK FOR A MOMENT OVER THE SHOULDER OF AN AGRONOMIST WHO IS STUDYING THE RESULTS OF AN AERIAL SURVEY. HE IS TRACING THE WORN OUT AREAS WHICH CAN BEST BE RESTORED BY GREEN MANURE ROTATION, SOIL BUILDING LEGUMES, AND WINTER COVER CROPS, AND HE IS MARKING AREAS WHICH WILL REQUIRE PERMANENT SEEDING. NOW THE RANGE EXPERT TAKES OVER THE AERIAL PICTURES AND HE EASILY AND QUICKLY LOCATES SPRINGS, SMALL STREAMS, SIGNS OF UNDERGROUND WATER AND GRAZING AREAS. THE WOODLAND EXPERT TAKES OVER THE MAP AND HE QUICKLY DETERMINES WHICH SECTIONS ARE BEST SUITED TO TREE CROPS. PERHAPS HE WILL FIND DISTRICTS WHICH HE BELIEVES SHOULD BE SET ASIDE FOR GAME FARMING.

THE AGRICULTURAL ENGINEER IS INTERESTED CHIEFLY IN THE GULLIES AND THEIR APPROXIMATE SIZE AND FROM THESE PICTURES, OR MAPS, HE CAN PRESCRIBE MEASURES TO CHECK THEIR SPREAD. HE CAN ALSO LAY OUT TERRACE-LINES, FENCES, AND ROADS AND EVEN LOCATE SMALL DAMSITES.

SO WE FIND THE AERIAL SURVEY LITERALLY KILLS TWO BIRDS WITH ONE STONE. BUT THAT IS NOT ALL. HAVE YOU EVER CONSIDERED THE VALUE OF SUCH A MAP TO THE COUNTY COMMISSIONERS' COURT OR TO A TAX ASSESSOR OR COLLECTOR?

PERHAPS AN ILLUSTRATION WILL BETTER EXPLAIN THE VALUE. WHEN AN AERIAL MAP WAS BEING MADE OF THE BRAZOS RIVER CONSERVATION AND RECLAMATION DISTRICT IT WAS DISCOVERED THAT SOME FARMS WHICH WERE BELIEVED TO CONTAIN SIX HUNDRED AND FORTY ACRES REALLY CONTAINED 800 AND MORE ACRES. IN THIS INSTANCE LANDOWNERS HAD MORE ACREAGE THAN THEIR DEEDS SHOWED THEY HAD, AND THE COUNTY WAS LOSING TAXES ON THIS ADDITIONAL LAND. WITH AERIAL PHOTOGRAPHS AND THE INSTRUMENTS AT HIS DISPOSAL TODAY AN ENGINEER CAN ACCURATELY MEASURE LAND, AND THE COST OF SUCH A SURVEY WOULD BE PAID MANY TIMES OVER BY ADDITIONAL TAX REVENUE.

ALREADY SOME EIGHT THOUSAND MAPS OF TEXAS HAVE LEFT THE DRAFTING BOARD; YET NONE OF THESE MAPS, NOT ANY GROUP OR COMBINATION, GIVES US AN ACCURATE MAP OF THE STATE. THIS IS DUE TO SEVERAL REASONS BUT CHIEFLY TO THE FACT THAT EACH ONE OF THESE MAPS WAS PREPARED FOR SOME PARTICULAR PURPOSE AND DRAWN TO VARYING SCALES.

SOME OF THESE MAPS ARE USELESS TO THE ENGINEER. THEY WERE MADE YEARS AGO WHEN SURVEYORS TOOK THEIR SIGHTS ON TREES AND OTHER LAND MARKS WHICH WE ARE UNABLE TO FIND WHEN WE ATTEMPT TO CHECK THEIR MAPS.

THE U. S. COAST AND GEODETIC SURVEY HAS BEEN RUNNING LINES THROUGH TEXAS AND AT CERTAIN SPOTS THEY HAVE ERECTED WHAT WE CALL BENCH MARKS. THESE BENCH MARKS ARE SMALL SLABS WHICH ARE PARTIALLY BURIED IN THE GROUND, CONTAINING TRIANGULATION MARKS AND SOME OTHER DATA. THEY ARE OF INVALUABLE AID TO THE SURVEYOR WHEN IN THE FIELD. YET SURVEYORS HAVE FOUND THESE BENCH MARKS IN USE AS CORNER STONES FOR FARM AND RANCH HOUSES; AS CORNER POSTS IN PASTURE FENCES AND AS DOOR STEPS. ONE PARTY OF SURVEYORS, WHILE RUNNING A LINE THRU THE BRAZOS RIVER CONSERVATION AND RECLAMATION DISTRICT, CAME ACROSS A MAN WHO WAS FURIOUSLY DIGGING UNDER A BENCH MARK. INQUIRY ELICITED THE INFORMATION THAT THE MAN, INTRIGUED BY THE TRIANGULATION MARKINGS, BELIEVED THAT IT MARKED THE HIDING PLACE OF A TREASURE TROVE. AND HE WAS DIGGING FOR THAT TREASURE.

AN AERIAL SURVEY WOULD ELIMINATE MANY OF THE UNCERTAINTIES AND THE NUMEROUS OTHER OBSTACLES WHICH CONFRONT US WHEN WE RESORT TO THE GROUND SURVEY METHOD.

WHAT WOULD SUCH A SURVEY COST? AND HOW LONG WOULD IT TAKE TO COMPLETE SUCH A MAP?

THESE TWO QUESTIONS HAVE BEEN GIVEN CONSIDERABLE THOUGHT AND STUDY NOT ONLY BY THE STATE RECLAMATION DEPARTMENT BUT ALSO BY THE TEXAS PLANNING BOARD'S

MAPPING COMMITTEE. THERE ARE TWO WAYS SUCH A SURVEY CAN BE MADE AND FINANCED. THE STATE ITSELF COULD UNDERTAKE THE JOB OR EACH ONE OF THE 254 COUNTIES IN TEXAS COULD UNDERTAKE AN AERIAL SURVEY OF THEIR OWN COUNTY. BUT IF THE COUNTIES SHOULD UNDERTAKE THIS WORK, IT WOULD BE IMPERATIVE THAT A STANDARD SCALE BE ADOPTED SO THAT WHEN THE NUMEROUS COUNTY MAPS ARE PIECED TOGETHER BY A CENTRALIZED BUREAU THEY WOULD MATCH PERFECTLY.

I BELIEVE SUCH A SURVEY OF THE STATE CAN BE MADE FOR $10,000,000.00 AND THE JOB COULD BE COMPLETED EASILY WITHIN FIVE OR SIX YEARS' TIME. IF THE STATE SHOULD UNDERTAKE THE PROGRAM, THE WORK COULD BE SO ARRANGED THAT THE FINANCING WOULD NOT BE TOO GREAT A BURDEN FOR THE TAXPAYERS.

THIS SUM MAY SOUND A BIT STAGGERING BUT IT WOULD COST MANY TIMES TEN MILLION DOLLARS TO MAKE A COMPLETE GROUND SURVEY OF THE STATE. FOR EXAMPLE, THERE ARE AREAS IN THE BIG BEND COUNTRY WHICH HAVE NEVER BEEN SURVEYED OR MAPPED. IT WOULD TAKE A GROUND CREW MONTHS AND MONTHS TO MAKE A COMPLETE SURVEY OF THIS REGION, WHEREAS AN AIR PHOTOGRAPHER WITH THE PROPER EQUIPMENT AND UNDER THE PROPER ATMOSPHERIC CONDITIONS COULD PHOTOGRAPH THE WHOLE BIG BEND COUNTRY IN TWO WEEKS' TIME, PROBABLY LESS.

I BELIEVE THE MAPPING OF TEXAS MERITS THE INTEREST AND SUPPORT OF EVERY COUNTY JUDGE AND EVERY COUNTY COMMISSIONERS' COURT IN THE STATE. THERE IS A CRYING NEED FOR A COMPLETE BASE MAP AND THE BENEFITS WHICH WOULD RESULT FROM THE POSSESSION OF SUCH A MAP CANNOT BE ENUMERATED.

YOU HAVE MANY PROBLEMS IN SOUTH TEXAS, ESPECIALLY ALONG THE GULF COAST COUNTRY, WHICH WOULD BE EASIER SOLVED THROUGH THE POSSESSION OF AN AERIAL MAP OR PHOTOGRAPHS. PROPER DRAINAGE WILL ENABLE TEXAS TO RECLAIM APPROXIMATELY 12,000,000 ACRES OF LAND ALONG THE COAST FOR THE GROWING OF GRAINS, AND FOR PASTURE LAND.

I HAVE CITED BUT A FEW INSTANCES OF THE NEED AND THE VALUE OF SUCH A MAP AND IN CLOSING WOULD LIKE TO LEAVE THIS THOUGHT - UNLESS ONE IS A HARDY ADVENTURER OR EXPLORER, IT IS DIFFICULT TO GO PLACES WITHOUT AN ACCURATE MAP.

PROFESSOR CHURCH'S ARTICLE DRAWS COMMENT FROM COLONEL BIRDSEYE

THE FOLLOWING LETTER FROM COLONEL C. H. BIRDSEYE WAS RECEIVED BY PROFESSOR EARL CHURCH, AUTHOR OF THE ARTICLE, "APPROXIMATE FARM SURVEYS FROM VERTICAL AERIAL PHOTOGRAPHS," PUBLISHED IN PHOTOGRAMMETRIC ENGINEERING FOR APRIL-MAY-JUNE, 1937:

MY DEAR CHURCH:

I WAS EXTREMELY INTERESTED IN YOUR ARTICLE.....IN READING IT, I FOUND SEVERAL APPARENT TYPOGRAPHICAL ERRORS AND ALSO HAD DIFFICULTY IN READING THE FORMULAE PRINTED WITH SMALL CAPS FOR LOWER CASE LETTERS.....

I CONSIDER THE ARTICLE SO INTERESTING, BUT STILL SO HARD TO READ IN THE LITHO-PRINT FORM, THAT I WISH YOU WOULD HAVE IT PRINTED AS ONE OF YOUR REGULAR BULLETINS. I MAKE THIS SUGGESTION, ...BECAUSE I BELIEVE THAT IT WOULD BE AN EXTREMELY VALUABLE ADDITION TO TEACHING TEXT ON PHOTOGRAMMETRY FOR OTHER UNIVERSITIES AND ALSO TO THE AGRICULTURAL ADJUSTMENT ADMINISTRATION FOR USE IN SCALE-CHECKING AND COMPUTING ACREAGE.

BESIDES THE TYPOGRAPHICAL ERRORS IN PHOTOGRAMMETRIC ENGINEERING, WHICH ARE LISTED BELOW, I FIND AT LEAST ONE APPARENT ERROR IN YOUR TEXT AND HAVE SEVERAL SUGGESTIONS WHICH I THINK WOULD IMPROVE YOUR TEXT.

ERRORS IN PRINTED TEXT:

PAGE 28, SEC. 1, PAR. 2, LINE 6, **o p** SHOULD BE **o pl .**

PAGE 28, 2ND FORMULA, **F D** SHOULD BE **f D.**

PAGE 31, CHANGE - TO ≡ IN FOUR FORMULAE AT TOP OF PAGE.

PAGE 34, INSERT GREEK DELTA BEFORE **x'** AND **y'** IN STEPS 4 AND 5.

PAGE 35, DITTO, UNDER DETERMINING BEARINGS OF FARM BOUNDARIES.

PAGE 34, INSERT **y'** ABOVE 43.91.

CHANGE ALL PARAGRAPH REFERENCES TO AGREE WITH TYPED NUMBERS. FOR EXAMPLE, ON PAGE 31 CHANGE "AS IN PARAGRAPH 4" TO "AS IN PARAGRAPH IV."