

$$\begin{array}{r} \text{PHOTO VI} \\ \text{AVI} - 5.09 + 32.50 \\ \text{DVI} - 3.06 - 21.94 \\ \hline 2.03 \quad 54.44 \end{array} \quad \begin{array}{l} \text{TAN} = .03729 \\ \text{PHOTO DIRECTION OF AVI/DVI} = \\ 177^\circ 51.8' \end{array}$$

$$\begin{array}{l} \text{GROUND AZIMUTH OF AVI/DVI} = 263^\circ 33.0' \\ \text{PHOTO DIRECTION OF AVI/DVI} = 177 \quad 51.8 \\ \hline \text{KVI} = 85 \quad 41.2 \end{array}$$

DETERMINING BEARINGS OF FARM BOUNDARIES

LINE	$\Delta x' / \Delta y'$ TAN	PHOTO DIRECTION	GROUND AZIMUTH (BY ADDING $85^\circ 41'.2$)
I-II	.01648	180° 56.7'	266° 38'
II-III	1/.00367	269 47.4	355 29
III-IV	.01055	180 36.2	266 17
IV-V	1/.01784	271 01.3	356 42
V-VI	.00172	0 05.9	85 47
VI-I	1/.00412	89 45.8	175 27

COMPARISON OF THE PHOTOGRAMMETRIC SURVEY
AND THE GROUND SURVEY OF THE FARM

LINE	PHOTOGRAMMETRIC SURVEY		GROUND SURVEY		DISCREPANCY	
	AZIMUTH	LENGTH	AZIMUTH	LENGTH	AZIMUTH	LENGTH
I-II	266° 38'	818 FT.	266° 25'	825 FT.	-0° 13'	+ 7 FT.
II-III	355 29	480	356 45	473	+1 16	- 7
III-IV	266 17	222	269 56	221	+3 39	- 1
IV-V	356 42	789	356 26	789	-0 16	0
V-VI	85 47	1023	85 39	1026	-0 08	+ 3
VI-I	175 27	1283	175 40	1289	+0 13	+ 6
	AREA = 27.85 ACRES		AREA = 28.02 ACRES		0.17 ACRE	

ALTHOUGH TWO OF THE BOUNDARY LINES SHOW RATHER LARGE DISCREPANCIES IN AZIMUTH BETWEEN THE PHOTOGRAMMETRIC AND THE GROUND SURVEYS, THIS IS NOT AT ALL SURPRISING BECAUSE THE BOUNDARY LINES IN QUESTION ARE VERY SHORT. IN ALL CASES WHERE THE BOUNDARY LINES HAVE ANY CONSIDERABLE LENGTHS THE AGREEMENT IN AZIMUTH IS GOOD. THE ERROR OF 0.17 ACRE IN THE PHOTOGRAMMETRIC DETERMINATION OF THE AREA REPRESENTS BUT LITTLE OVER ONE-HALF OF ONE PERCENT.

IT IS BELIEVED THAT THIS QUICK AND CHEAP METHOD FOR MAKING SURVEYS OF MANY FARMS WILL PROVE RATHER USEFUL IN MODERN ECONOMIC PROJECTS.

MODERN MAPS FOR COLOMBIA BY AERIAL METHODS

BY

R. H. LASCHE

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"HE'LL SPREAD OUT THAT COSTLY, ORNATE, LYING AND DEFICIENT MAP THAT THE OFICINA DE LONGITUDES OF BOGOTA DREW UP, AND AFTER MUCH SEARCHING HE'LL SAY: 'THERE ARE NO SUCH RIVERS HERE.' AND QUITE SATISFIED, HE'LL CONTINUE ENTRENCHED IN HIS IGNORANCE, BECAUSE THIS POOR COUNTRY ISN'T KNOWN BY ITS OWN SONS, NOT EVEN BY ITS GEOGRAPHERS."

THESE WORDS FROM JOSE EUSTASIO RIVERA'S BOOK, "THE VORTEX," APTLY DESCRIBE A CONDITION WHICH, UNTIL RECENTLY, HAD EXISTED IN COLOMBIA SINCE ITS BEGINNING--A CONDITION WHICH STILL EXISTED UPON MY ARRIVAL THERE LESS THAN THREE YEARS AGO.

ALMOST EVERY MODERN NATION KNOWS WHAT RIVERS, MOUNTAINS AND LANDMARKS LIE WITHIN ITS BORDERS--BUT IN COLOMBIA THE VERY NATURE OF THE TERRAIN ITSELF KEPT THESE THINGS A HIDDEN SECRET. THE COLOMBIAN GOVERNMENT HAD RECOGNIZED FOR MANY YEARS THE NECESSITY FOR ACCURATE AND DETAILED MAPS BUT INSURMOUNTABLE OBSTACLES STOOD IN THE WAY OF ORDINARY GROUND SURVEY METHODS OF MAPPING. VAST AREAS OF THE COUNTRY CONSIST OF FLAT PLAINS WHICH SWELTER UNDER A BLAZING

EQUATORIAL SUN AND STILL LARGER PORTIONS OF STEAMING, MOSQUITO-INFESTED JUNGLES, SO DENSE THAT THE SUN NEVER ENTERS. AND ACROSS THE PLAINS AND THROUGH THE JUNGLES FLOW NUMEROUS RIVERS LIKE THE AMAZON, PUTUMAYO, THE META AND THE MAGDALENA--QUIET AND PEACEFUL AT ONE POINT, RAGING TORRENTS AT ANOTHER--ALWAYS THEIR MURKY SURFACES CONCEALING OROCODILES AND THE VORACIOUS CARIBE FISH, THE LATTER WHICH SEEMINGLY APPEAR FROM NOWHERE BY THE HUNDREDS TO DEVOUR IN A FEW MINUTES ANY HAPLESS VICTIM, HUMAN OR OTHERWISE, WHICH MAY FALL TO THEIR PREY.

WITH SUCH OBSTACLES FACING THE SURVEYOR WHO WOULD VENTURE TO MAP THIS TROPICAL LAND IT IS LITTLE WONDER THAT COLOMBIA HAD FEW MAPS OF PRACTICAL VALUE.

WITH THE ADVENT OF AERIAL CAMERAS--AND SYSTEMS OF AERIAL MAPPING BY WHICH MAPS CAN BE ASSEMBLED, A SOLUTION TO THIS PROBLEM AT LAST WAS OFFERED.

OFFICIALS OF THE COLOMBIAN GOVERNMENT, ANXIOUS TO LEARN THE BEST METHODS FOR MAPPING THEIR COUNTRY, OFFERED CLOSE COOPERATION TO ASSIST IN DEVELOPING A GOOD SYSTEM FOR MAKING PERFECT MAPS. VARIOUS METHODS HAVE BEEN DEVELOPED IN DIFFERENT PARTS OF THE WORLD BUT ALL ARE NOT SUITABLE FOR MAPPING THEIR COUNTRY. IN EUROPE, FOR EXAMPLE, SEVERAL SYSTEMS HAVE BEEN DEVELOPED WHICH INCORPORATE THE STEREO PLOTTING METHOD IN MAP MAKING BUT THESE SYSTEMS ARE NOT PRACTICAL FOR A LARGE UNMAPPED AREA LIKE COLOMBIA WHERE THERE IS LITTLE OR NO GROUND CONTROL. THE SYSTEM OF AERIAL MAPPING USING T-3A FIVE-LENS CAMERAS IS FAR SUPERIOR UNDER THESE CONDITIONS AND WITH SLIGHT VARIATIONS WILL WORK OUT SATISFACTORILY.

PREVIOUS TO MY ARRIVAL IN COLOMBIA, THE GOVERNMENT HAD PURCHASED CONSIDERABLE CAMERA EQUIPMENT BUT IT HAD NOT BEEN USED DUE TO LACK OF ADEQUATE LABORATORY FACILITIES FOR DEVELOPMENT AND PRINTING THE PHOTOGRAPHS. THIS EQUIPMENT CONSISTED OF SINGLE-LENS K-3 AND K-3B CAMERAS WITH VERTICAL VIEW FINDERS, CONTACT PRINTERS AND A LARGE COPYING CAMERA. MY FIRST TASK, THEREFORE, WAS TO SET UP SOME KIND OF TEMPORARY LABORATORY SO THAT THE FILMS EXPOSED ON OUR PRELIMINARY PHOTOGRAPHIC MISSIONS COULD BE DEVELOPED AND SHOWN TO THE GOVERNMENT OFFICIALS. WHILE THIS WAS BEING ARRANGED IN ONE ROOM OF THE GARRISON AT CALI A SELECTED GROUP OF PILOTS AND STUDENTS RECEIVED A BRIEF COURSE OF INSTRUCTION IN AERIAL PHOTOGRAPHY. SOON THE FIRST IMPORTANT AERIAL PHOTOGRAPHIC EXPEDITION EVER ATTEMPTED IN COLOMBIA WAS READY TO START OUT.

IN OCTOBER 1934 OUR EXPEDITION LEFT FROM THE BASE AT PALENQUERO ON THE MAGDALENA RIVER FOR AN EXTENSIVE SURVEY OF THE RIVERS AND PLAINS EAST OF THE ANDES MOUNTAINS. PREPARATIONS FOR THIS EXPEDITION WERE MADE MONTHS IN ADVANCE. IN FACT, ALL OF THE GASOLINE WE USED ON THIS EXPEDITION HAD BEEN SENT OVER THE ANDES MOUNTAINS ON MULE PACK SEVERAL MONTHS BEFORE WE TOOK OFF--A PACK TRAIN OF OVER 200 MULES CARRYING OUR GASOLINE AND SUPPLIES, FOR THERE ARE NO RAILROADS OR HIGHWAYS OVER THE MOUNTAINS. FROM PALENQUERO WE FLEW TO GIRARDOT, REFUELED AND THEN FLEW OVER THE MOUNTAINS TO OROQUE ON THE META RIVER. UNFORTUNATELY, WE WERE UNABLE TO COMPLETE THE FLIGHT TO OROQUE BECAUSE OF THE DARKNESS AND WERE FORCED TO LAND ON A SMALL RANCH IN THE VICINITY OF PUPURE. SLEEPING ACCOMMODATIONS WERE MEAGRE. SOME OF US SLEPT ON SMALL SANDBARS ON THE RIVER AND SOME SLEPT ON THE MAINLAND. THE NEXT MORNING WE TOOK OFF FOR OROQUE WHICH WAS THE FIRST SETTLEMENT WE HAD SEEN EAST OF THE ANDES. IT IS A SMALL VILLAGE OF APPROXIMATELY 70 HOUSES DESCRIBED SO WELL BY JOSE EUSTASIO RIVERA IN HIS BOOK, "THE VORTEX". FROM OROQUE WE FLEW NORTH TO ARACUA AND THEN IN A SOUTHEASTERLY DIRECTION TO PUERTO CARANO. FROM HERE SEVERAL SURVEY FLIGHTS WERE MADE UP TO THE HEADWATERS OF THE ORINOCO RIVER AND ACROSS VAST PLAINS WHICH ARE INHABITED ONLY BY INDIANS AND WILD CATTLE. IT WAS A HISTORY-MAKING FLIGHT FOR COLOMBIA AND IS THE BASIS FOR A STORY BY MR. L. E. NEITO CABALLERO ENTITLED, "VUELO AL ORINOCO".

UPON OUR RETURN TO THE LABORATORY AT CALI WE WORKED DAY AND NIGHT DEVELOPING FILMS AND MAKING CONTACT PRINTS. THE RESULTS OF THIS EXPEDITION WERE SO GRATIFYING THAT THE OFFICIALS OF THE GOVERNMENT IMMEDIATELY REQUESTED THAT WE PROCEED WITH PLANS FOR BUILDING A COMPLETE PHOTOGRAPHIC LABORATORY. THE FINAL LAYOUT CONSISTED OF A 15-ROOM BUILDING WITH EVERY FACILITY, NOT ONLY FOR PHOTOGRAPHIC PURPOSES BUT FOR MAPPING WORK. PROVISION WAS MADE FOR ACCOMMODATING PRESENT EQUIPMENT, SUCH AS THE K-3 AND K-3B CAMERAS, AND ALSO FOR USING RESTITUTIONAL PRINTERS REQUIRED BY THE T-3A CAMERAS. EACH DARK ROOM

CONTAINED ITS OWN INDIVIDUAL VENTILATING SYSTEM AND THE ELECTRICAL WIRING WAS OF THE PROPER TYPE FOR THE VARIOUS PIECES OF EQUIPMENT.

AS THE LABORATORY WAS BEING CONSTRUCTED GROUND COURSES IN AERIAL PHOTOGRAPHY WERE STARTED ON A MORE EXTENSIVE SCALE. EVERY STUDENT PILOT WAS GIVEN A THOROUGH COURSE IN BASIC PHOTOGRAPHY, PHOTOGRAPHIC CHEMISTRY AND AERIAL PHOTOGRAPHY. AFTER A SUFFICIENT TRAINING AT THE BASE, THE STUDENTS WERE SENT OUT ON PHOTOGRAPHIC MISSIONS TO OBTAIN BOTH OBLIQUE AND VERTICAL PHOTOGRAPHS. ONE CLASS, AS A FINAL PROJECT, MAPPED A LARGE AREA INCLUDING THE CITY OF CALI AND LAID MOSAIC MAPS OF THIS AREA APPROXIMATELY 6 BY 12 FEET IN SIZE. DURING THIS TRAINING WORK THE STUDENTS PERFORMED ALL OF THE WORK THEMSELVES, LOADED THEIR OWN CAMERAS, DEVELOPED THEIR OWN FILM AND MADE THEIR OWN PRINTS.

VARIOUS GOVERNMENT DEPARTMENTS, WHICH HAD SEEN THE RESULTS OF THE FIRST EXPEDITION, WERE SO INTERESTED IN AERIAL PHOTOGRAPHY THAT THEY REQUESTED OTHER MISSIONS BE FLOWN. BECAUSE THIS WORK HAD TO BE CARRIED ON DURING THE PERIOD OF INSTRUCTION IT WAS NECESSARY TO MAKE THESE TRIPS AS SHORT AS POSSIBLE. ONE MISSION OF GREAT IMPORTANCE WAS MADE UP TO SANTA MARTA IN ORDER TO ASSIST IN THE LOCATION OF A SITE FOR A TUBERCULOSIS SANITARIUM. INASMUCH AS COLOMBIA IS CONSIDERED TROPICAL COUNTRY IT WAS NECESSARY TO FIND A SITE THAT WAS COOL AND DRY. AERIAL PHOTOGRAPHS NOT ONLY WERE USED TO LOCATE THE ACTUAL SITE BUT ALSO TO ASSIST IN THE LOCATION OF A HIGHWAY FROM THE TOWN OF SANTA MARTA TO THE HOSPITAL SITE.

ANOTHER EXPEDITION WAS MADE DOWN INTO THE AMAZON REGION TO SURVEY VARIOUS AREAS THAT WERE OF ALL IMPORTANCE TO THE GOVERNMENT. WEATHER CONDITIONS IN TROPICAL REGIONS ARE FAR FROM IDEAL FOR AERIAL PHOTOGRAPHY AND ON THIS MISSION IT WAS NECESSARY TO WAIT SEVERAL DAYS IN ORDER TO OBTAIN GOOD PHOTOGRAPHIC WEATHER.

THE VALUE OF AERIAL PHOTOGRAPHS IN REGIONS COVERED BY JUNGLE IS BEST ILLUSTRATED BY ONE EXPEDITION THAT SET OUT TO FIND A WATER SUPPLY FOR ONE OF THE MILITARY BASES. IN MOST OF THIS JUNGLE REGION FRESH WATER IS HARD TO FIND, ESPECIALLY ALONG THE SEA COAST. MOST OF THE DRINKING WATER IS RAIN WATER CAUGHT IN LARGE DRUMS. IN THESE JUNGLES IT RAINS EVERY DAY SO THERE IS LITTLE OR NO DANGER OF WATER SHORTAGE, BUT THERE IS GREAT DANGER OF DISEASE BECAUSE MOSQUITOES AND OTHER INSECTS BREED IN THE OPEN WATER. NOT FAR FROM THIS MILITARY BASE IT WAS NOTED, WHEN FLYING, THAT A SECTION OF THE JUNGLE SEEMED A LITTLE GREENER IN COLOR THAN THE SURROUNDING JUNGLE. IT WAS ALMOST IMPOSSIBLE TO GET INTO THIS REGION ON FOOT SO A SERIES OF AERIAL PHOTOGRAPHS WERE MADE AND STUDIED UNDER A STEREOSCOPE. AFTER CAREFUL STUDY IT WAS FOUND THAT THE PATCH OF BRIGHT GREEN WAS VERY REGULAR IN SHAPE AND LEADING OFF FROM IT SEEMED TO BE A DISTINCT PATH CUT THROUGH THE JUNGLE. IT WAS IMPOSSIBLE TO DETERMINE WHAT THIS SHARP PATH MIGHT BE AS THERE WERE NO POWER LINES OR ROADS THROUGH THAT PART OF THE JUNGLE. FINALLY, A GROUND CREW WAS SENT IN AND UPON INVESTIGATION FOUND THAT THE PATH THROUGH THE WOODS CONTAINED AN OLD WOODEN PIPE LINE AND THAT THE GREEN PATCH IN THE JUNGLE WAS A LARGE FRESH WATER SPRING. HERE WE FOUND A SMALL DAM AND PARTS OF A WATER WHEEL WHICH HAD BEEN BUILT BY THE SPANIARDS HUNDREDS OF YEARS AGO--NOW COMPLETELY OVERGROWN BY THE JUNGLE.

A YEAR AND A HALF OF INTENSIVE TRAINING DEVELOPED MANY FINE PHOTOGRAPHIC PILOTS, AERIAL PHOTOGRAPHERS AND LABORATORY MEN. MY CONTRACT HAVING EXPIRED, I RETURNED TO THE UNITED STATES--BUT THE WORK OF COMPILING ACCURATE DETAILED MAPS OF COLOMBIA GOES FORWARD, UNHAMPERED BY THE PERILS OF TREACHEROUS JUNGLES AND UNFRIENDLY INDIANS, FOR TODAY COLOMBIA IS BEING MAPPED FROM THE AIR.