DAILY ASSESSMENT FORMAT

Date:	30th June 2020	**Name:**	Soundarya NA
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FORENOON SESSION DETAILS
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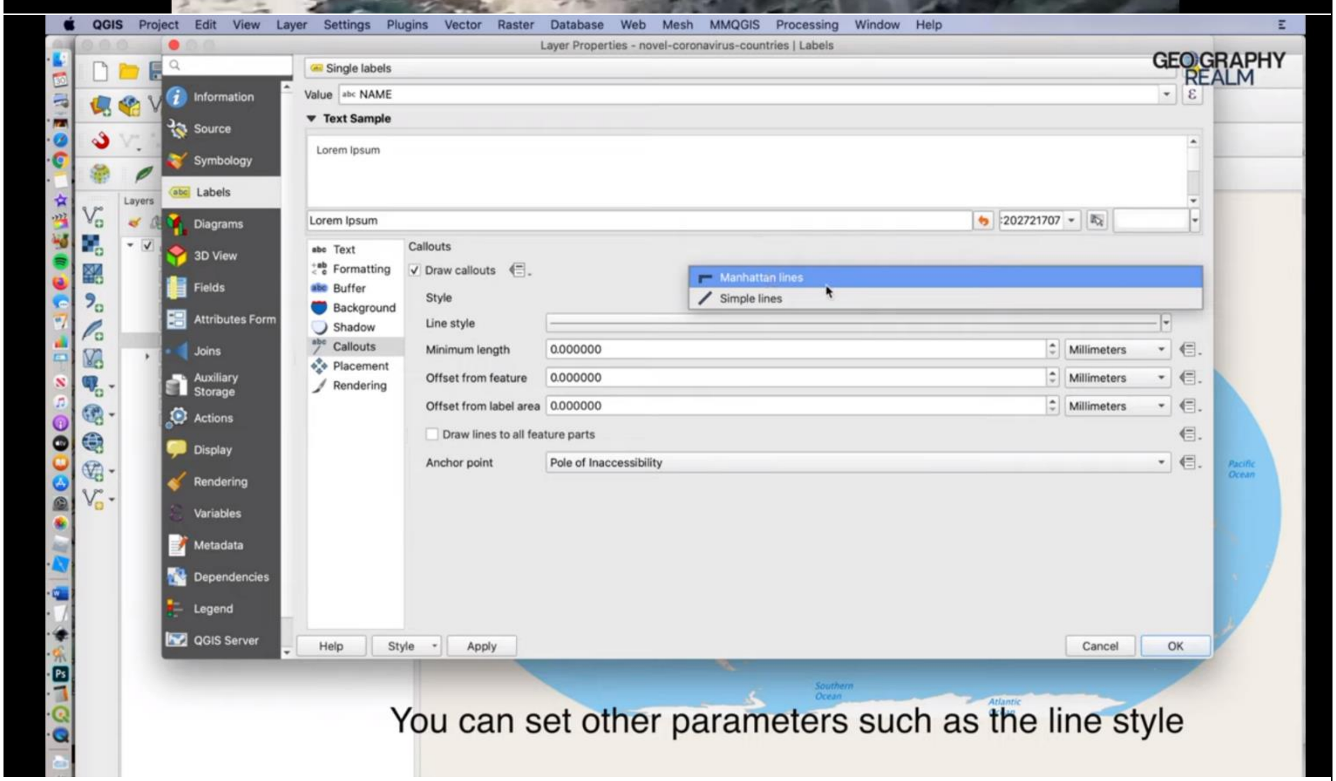

Report:

Instrumented, unmanned earth satellites are now an accomplished fact. Manned satellites are feasible, and may be an accomplished fact within a decade. In the meantime, International Geophysical Year studies of the upper atmosphere and adjacent space are providing data upon which to base the designs of future satellite vehicles, satellite instruments, and satellite-borne cameras.

Consequently, it is timely for the photogrammetrist to consider the potential uses of earth satellites and space stations, manned as well as unmanned, for nonmilitary photogrammetric purposes. l This paper therefore proposes and discusses future photographic and electronic methods and systems for photogrammetry from earth satellite vehicles, the advantages of such methods, and the attendant problems and difficulties.

Prior to discussing earth satellite photogrammetry as such, it is pertinent to summarize some basic facts and data concerning satellites and their orbits. The orbit of an earth satellite is an ellipse with the center of the earth at one focus. (The eccentricity of the elliptic orbit can be zero, in which case the orbit becomes a circle with the earth at the center.)

Once launched in its orbit, a satellite remains aloft without further propulsive force because the gravitational attraction of the earth upon the satellite is equal to the centrifugal force of the satellite's orbital motion. This balance results in an apparent weightlessness, as if the satellite and its payload were in a field of zero gravity. (Con trary to popular misconception, gravity acts continually upon the satellite; indeed, gravity keeps the satellite in its orbit.)

The orbit of a satellite must lie in a plane passing through the mass centroid of the earth. (It is not possible, for example, for a satellite to circle the earth in a stable orbit lying in the plane of any parallel of latitude except the equator.) If there be neglected the orbit's precession (which is due principally to the non-spherical shape of the earth), the normal to the orbital plane of a satellite can be thought of as fixed in direction in space, independent of the earth's diurnal rotation. There are three possible types of orbital planes: the plane of the equator; planes passing through the poles; and planes at intermediate angles. The equatorial orbit is least likely to be useful for photogrammetric purposes because in this orbit the satellite can view only the areas in an equatorial belt of limited width. On the other hand, a polar orbit will enable a photogrammetric satellite to survey all areas of the earth. The projection of a polar satellite's path upon the earth's surface is like a ball of string wound so that every turn of string passes over the poles, eventually covering all points on the earth.

The third type of orbital plane (at an angle intermediate between the equatorial and polar planes) was chosen for the satellites 1957 Alpha, 1957 Beta, and 1958 Alpha. The angles of these orbital planes with the equatorial plane are given in the last row of Table 1. In this type of orbit, the projected path of the satellite traces a basket-weave pattern on the earth, in a band between two parallels of latitude equally spaced on either side of the equator. Part of this pattern is diagrammed in Figure 2 for a satellite in a 90 minute circular orbit that crosses the equator at an angle of 40°, which is approximately the angle expected for the U. S. Vanguard satellites. The figure shows the first, second, third, fifteenth and sixteenth revolutions of this satellite, the orbital period of which is one sixteenth of the period of the earth's diurnal rotation. A photogrammetric satellite launched in the same orbital plane as 1957 Alpha and 1957 Beta could survey the entire area of the earth from latitude 65° North to latitude 65° South.

A camera at satellite altitude has the advantage of very wide coverage. For example, at an altitude of 1,600 miles, which is the apogee of Explorer I, a lens with a 90° field of view will photograph more than one-third the area of the entire earth in one exposure from horizon to horizon. Wide coverage photographs such as these should be valuable for geodetic purposes, to tie in more accurate large-scale surveys.

A 6-inch focal-length lens at the aforementioned 1,600-mile altitude will give photography at a scale of approximately one to twenty million. This scale is obviously too small for useful topographic mapping, unless the resolution and definition of lenses and photographic emulsions were to be improved far beyond anything presently available.

Lower satellite altitudes are obviously more desirable, or shall we say less undesirable, for topographic mapping. 150 miles was assumed to be the minimum altitude for a photogrammetric satellite, in the discussion of satellite orbits and lifetimes earlier in this paper. Even at this altitude, a 6-inch focal-length lens takes a photograph at a scale of approximately one to two million. This scale will not give a resolution or C factor high enough for topographic mapping by conventional accuracy standards. It is therefore concluded that satellite photography with conventional photogrammetric cameras would be useful only for planimetric mapping at small scales, and for tie-in of large-scale surveys made by other photography.

A high degree of stabilization is obviously important for cameras at altitudes of hundreds of miles. For example, an accuracy of 20 feet on the ground, from an altitude of 150 miles, corresponds to a stabilization of 5 seconds of arc. Fortunately, high stabilization may not be too difficult to achieve because an orbiting satellite moves and spins smoothly without the random accelerations that conventional airborne aircraft experience. However, it is not sufficient to stabilize a satellite camera with respect to an inertial frame of reference, because the camera will then point vertically downward toward the earth's surface only once in each revolution of the satellite around the earth. Nor is it sufficient to give the camera (or satellite) a constant spin (about an axis perpendicular to the orbital plane) in order to keep the camera pointing normal to the earth's surface; this will work for a circular orbit only; it will not work for an elliptic orbit because the radius vector from the center of the earth to the satellite does not rotate with constant angular velocity. Consequently the camera must be driven to rotate with varying angular velocity, depending upon the orbit, to make the camera always point vertically down upon the earth's surface.