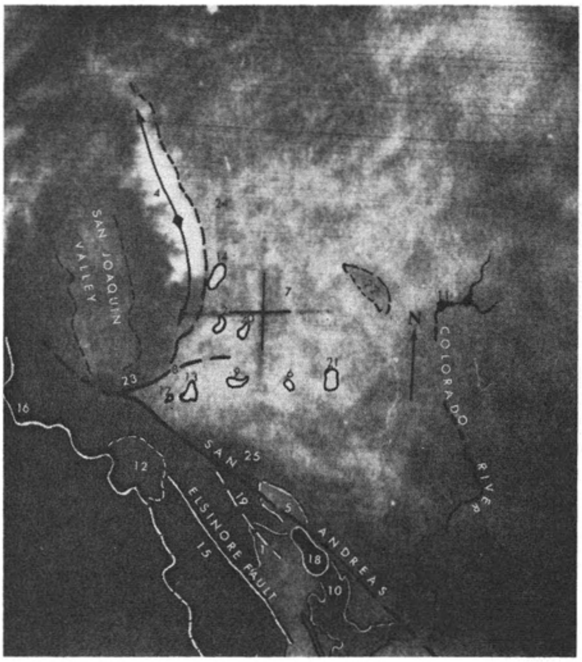

FIG. 1. Mojave Desert including major faults, valleys and mountain ranges of the Basin and Range Province. *Picture data:* TIROS I, Orbit 21, Camera 2 (wide angle), Frame 6, April 2, 1960, High Oblique. *Key to Locations:* (1) Borrego Desert; (2) China Lake; (3) clouds; (4) Sierra Nevada; (5) Coachella Valley; (6) Coyote Dry Lake; (7) Death Valley; (8) Garlock Fault; (9) Harper Dry Lake; (10) Imperial Valley cultivated area; (11) Lake Mead; (12) Los Angeles Basin; (13) Muroc Dry Lake; (14) Owens Lake; (15) Peninsular Ranges; (16) Point Conception; (17) Rosamond Dry Lake; (18) Salton Sea; (19) San Jacinto Fault; (20) Searles Dry Lake; (21) Soda Dry Lake; (22) Spring Mountains; (23) Tehachapi Mountains; (24) White Mountains; (25) San Bernardino Mountains.

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Terrain Seen from TIROS

Satellite video pictures record significant geological detail particularly in semi-arid lands and snow and ice regions.

INTRODUCTION

PICTURES FROM TIROS I through VII were available for this study. Each satellite carried one wide-angle camera (104° field) and either a narrow-angle camera (12.7° field), a medium-angle camera (76° field) or a second wide-angle camera. Images from the cameras were focused on 0.5-inch vidicon tubes at the focal planes and scanned at 500 raster lines per frame; the signals were subsequently transmitted or stored on tape. The spectral response of the vidicon tubes ranged from 450 to 850 millimicrons with a peak around 550 millimicrons. Resolution of the telemetered pictures was limited primarily by the electronic components of the system; Erickson and Hubert, 1961 (Ref. 2) estimated the maximum theoretical ground resolution to be 2.4 km. for the wide-angle camera and 230 m. for the narrow-angle camera of TIROS I. The resolution of later TIROS systems was only slightly improved. These ground resolutions are approached by linear objects such as rivers whose images tended to be perpendicular to the raster lines, but the resolution of irregularly shaped objects or linear objects running parallel to the raster lines is much less, at least twice these values.

The useful coverage of the Earth was limited to a belt between 60° north and 60° south by a 48° to 58°-range in inclination of the orbits. The low-eccentricity orbits averaged roughly 750 km. to 800 km. in altitude, with orbital periods of about 100 minutes. The useful life of the satellites varied from three months to one year.

SELECTED TIROS PICTURES

MOJAVE DESERT

The TIROS I picture in Figure 1 covers southern California, Arizona, Nevada and part of Utah. The Panamint Mountains of eastern California are shown at approximately the center of the photograph. Topographic relief is not observable. The markings in the photograph represent variations in albedo owing to differences in the nature of the surface. The surface in this region is well known, and it is possible to determine which features are visible. Several relative levels of gray tone are distinguishable. It should be useful first of all to group those features or surface types which have similar tone,* pointing out also any variations in texture. Only about half the photograph surrounding the principal point is useful because of barrel type lens distortion.

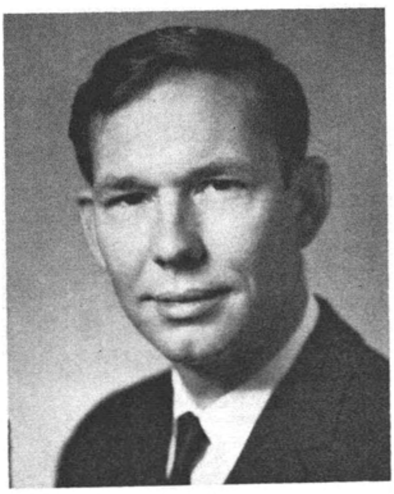
The darkest, most even-textured tone is displayed by large bodies of water, the Pacific Ocean, the Salton Sea and Lake Mead. Water always has the darkest appearance (except for space) in TIROS pictures unless specular reflection is achieved.

Heavily vegetated areas are not quite as dark as the seas and have a more irregular texture resulting from incomplete cover. Examples are the Peninsular ranges of southern California (15),† the San Bernardino Mountains (25) and the western slope of the Sierra Nevada. The same appearance is also imparted by the well-cultivated and irrigated Imperial Valley of south-central California (10). Some especially dark areas of outcrop have similar tone and texture. For example, the very sparsely vegetated Spring Mountains of Nevada (22) are indistinguishable from heavily forested areas.

Discontinuously cultivated and populated areas, such as the San Joaquin Valley, and the Los Angeles and Ventura basins display an intermediate tone and a rather rough texture. But parts of the naturally wooded highlands south of Lake Mead have a similar appearance.

ABSTRACT: *Major physiographic and geologic features are visible in some TIROS pictures, particularly those of arid regions where light-toned alluvial surfaces contrast sharply with darker bedrock of the uplands. However, surface detail is effectively masked by vegetation except where snow and ice disclose drainage patterns and structural lineations. Although TIROS pictures do not record a wealth of terrain information, their study may be of value in the interpretation of small-scale, low-resolution pictures of planetary surfaces televised from fly-by probes.*

Somewhat lighter tone characterizes the largely barren desert ranges. In the Mojave Desert region ranges are distinct from the intervening basins. The darker tone of the ranges probably is due to the broken relief producing internal shadow, the dark color of the rocks and sparse vegetation. The White Mountains of California (24) are a typical example. The desert valleys of the Basin and



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* Reference is made to relative tone or albedo within a single photograph. The determination of absolute albedo is not practical because of uncontrollable parameters in creating the photographs and imprecise knowledge of the phase angle of illumination. Relative albedos also change somewhat in a single photograph owing to change in phase angle across the curved surface of the Earth and various electronic distortions.

† Numbers refer to localities on the annotated photographs.

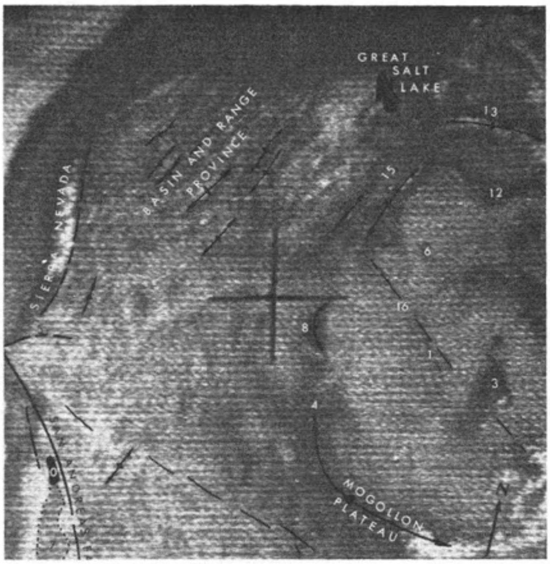

FIG. 2. Colorado Plateau including much of the Western United States such as the Great Salt Lake' Mogollon Plateau, Sierra Nevada and San Andreas Fault. *Picture data:* TIROS IV, Orbit 1727, Camera (1) (wide angle), Frame 4, June 1962, High Oblique. *Key to Locations:* (1) Black Mesa; (2) Cerro Pinacate; (3) Chuska Mountains; (4) Coconino Plateau; (5) Garlock Fault; (6) Henry Mountains; (7) Imperial Valley cultivated area; (8) Kaibab Plateau; (9) Natanes Plateau; (10) Salton Sea; (11) Sierra San Pedro Martir Fault; (12) Tavaputs Plateau; (13) Uinta Mountains; (14) Uncompahgre Mountains; (15) Wasatch Mountains; (16) Navajo Mountain; (17) Texas Lineament.

Range Province are lighter in tone than the mountains, owing to their smooth, barren, light-colored surfaces of alluvium.

Lighter still, however, are the dry lake beds with their flat, smooth floors of salts and clays. These are the brightest land features in the picture, and their texture is characteristically smooth. Examples of dry lakes are Muroc Lake (13), Searles Lake (20) and Owens Lake (14). The lightest tone is due to clouds, which occur over the Pacific Ocean, and snow along the crest of the Sierra Nevada.

The Colorado River can be traced with difficulty for part of its course south of Lake Mead. The San Andreas and Garlock faults can be traced by their geomorphic manifestations. The San Andreas marks the west border of the Mojave Desert, and the Garlock separates the wooded Tehachapi Mountains from the Mojave Desert. The Elsinore fault zone is barely discernible, mainly because of the rivers that follow its trend. An attempt was made to map the San Jacinto fault, but its position on the photograph is uncertain.

COLORADO PLATEAU

The Colorado Plateau and the area to the west are pictured in the TIROS IV photograph in Figure 2 taken in early June, 1962. A large cloud blanket parallels the Pacific Coast. Cumulus clouds or snow cover many of the interior ranges, including the Sierra Nevada, many of the ranges in Nevada, the Wasatch and Uinta mountains of Utah, the Rocky Mountains and mountains in west-central New Mexico.

The bi-tonal pattern of the Colorado Plateau can be explained by referring to a vegetation map of the region. The dark tone is produced by forests which are restricted mostly to highlands above 1,800 m. Hence, the dark areas indicate, in general, the elevations above the mean level of the plateau. Abundant Cenozoic volcanics occur within the dark areas that ring the Plateau, but these areas do not differ in appearance from those lacking volcanics. For example, volcanics are abundant in the southern extension of the Wasatch Mountains west of the Henry Mountains (6). This area is similar in appearance to the Tavaputs Plateau (12), which is nonvolcanic.

The lighter of the two predominant tones in the Colorado Plateau region represents the Colorado Plateau proper, which is essentially flat and sparsely vegetated. It displays a tone similar to the unvegetated ranges of the Mojave and Sonora desert regions. The great canyons of the Colorado, Green and San

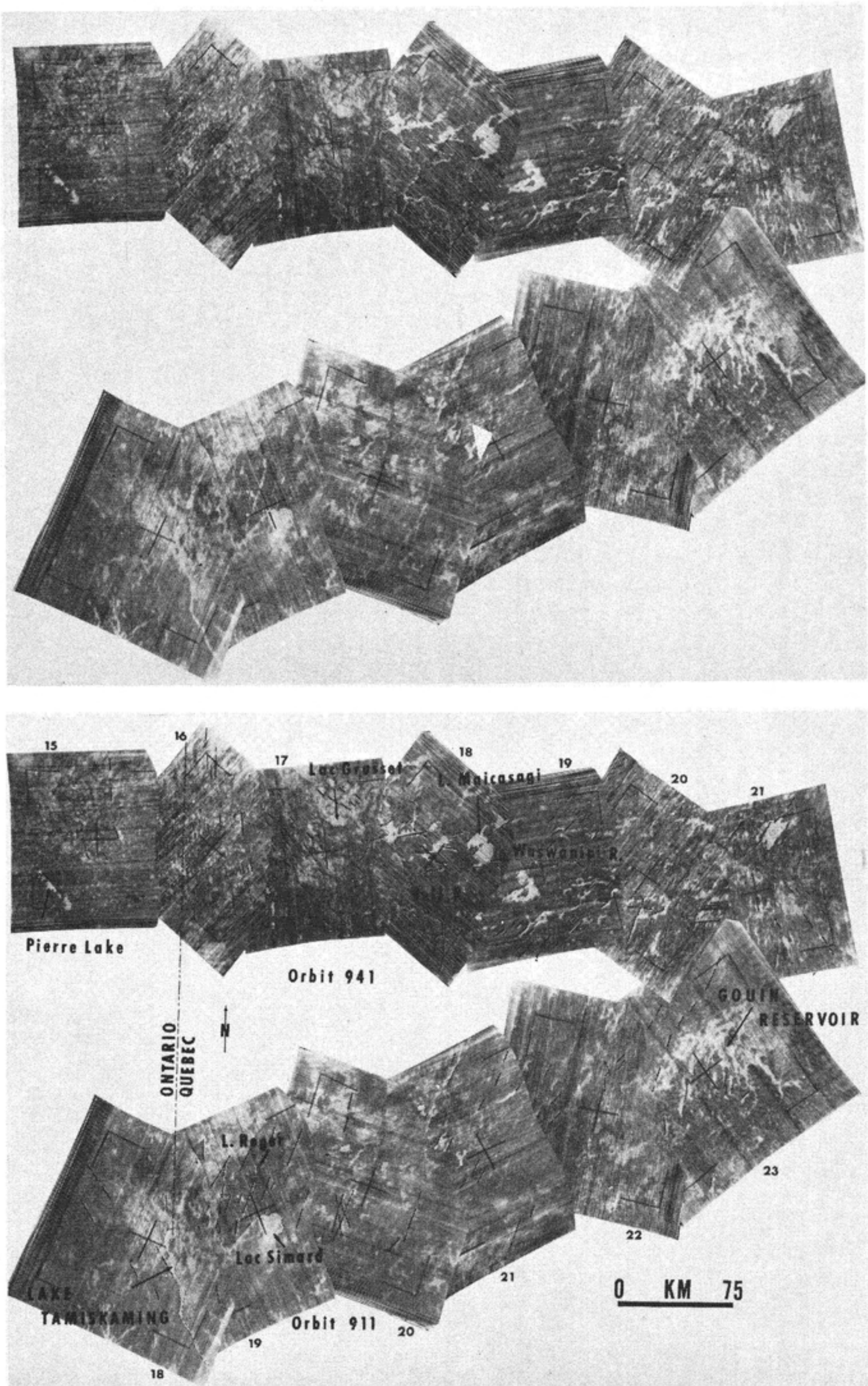

FIG. 3. Southeastern Canada. Strip mosaics of portions of Southern Ontario and Quebec show snow and ice, and glacial and tectonic lineaments. *Picture data:* TIROS II, Camera 1 (narrow angle), Frames 15–21 (Orbit 911) and 18–23 (Orbit 941), Jan. 24 and 26, 1960. Low Oblique (maximum tilt about 12°).

FIG. 4. Index map of Southeastern Canada. Dashed lines show the approximate areas covered in Figure 3.

Juan rivers are not detectable, perhaps because of the oblique angle of view. The Zuni lineament, however, shows up as a northwesterly alignment of dark spots representing highlands, such as Navajo Mountain (3,160 m. elevation at 16). A very crude lineation which may represent part of the Texas lineament has also been mapped (17).

SOUTHEASTERN CANADA

Figure 3 is a mosaic of TIROS II narrow-angle pictures taken on two orbits in January, 1960. The areas covered are in the southern portions of the Canadian Provinces of Ontario and Quebec (see index map, Fig. 4). The photographs were originally enlarged to a scale of 1:1,000,000 and the mosaic constructed over the World Aeronautical Charts, Numbers 220, 221, 263 and 264. By comparing the location of the photographs with the satellite's orbit, maximum tilt was estimated to be 12 degrees.

The mosaic includes areas of relatively low relief with many lakes, marshes and rivers. The high albedo exhibited by bodies of water indicates that they were frozen over and probably covered with snow, because snow is present on the land areas. Fresh snow and ice have similar albedos and may be difficult to distinguish. In this region, however, ice exhibits a uniform texture and forms sharp contacts with lake shores and river banks. Areas of snow have fuzzy boundaries and irregular texture resulting from vegetation. Evidently the snow covers the ground but has melted from the vegetation. The patches of high reflectance are probably treeless areas, whereas the dark areas are forested.

The lineations, which are emphasized by ice and snow, are the most interesting features of the mosaic. They are produced by such features as (1) quasi-parallel alignment of small lakes and snow-filled valleys (e.g., Orbit 941, Frame 17), (2) unusually long, narrow lakes (e.g., Lake Roger, Orbit 911, Frame 19, (3) straight river valleys (e.g., Waswanipi River, Orbit 941, Frame 19), (4) straight shores of lakes and the alignment of lake shores (e.g., Harris Lake and Pierre Lake, Orbit 941, Frame 15; western shore of Lake Tamiskaming, Orbit 911, Frame 18; southeastern shoreline of Maicasagi Lake, Orbit 941, Frame 19).

Some of the lineations visible in the mosaic appear on existing geologic maps (Refs. 4, 5, and 8). The straight edge of Harris and Pierre Lakes (Orbit 941, Frame 15), which trends N 45°W, is in good agreement with the high-angle fault shown on the Tectonic Map of Canada (Ref. 8). The other lineations on Frames 15 and 16 are created by finger lakes trending north-northwest and north. This trend is in best agreement with Pleistocene glacial lineations shown on the Glacial Map of Canada (Ref. 5), which were mapped on the basis of glacial features, including drumlin groups, crag and tail features and large glacial grooves.

Eastward through Frames 18, 19 and 20 (Orbit 941) the north trend agreeing with glacial movement persists, although it is less prominent. A new trend striking east-northeast appears in Frames 18 through 20 agreeing with the strike of foliation in the country rock as well as the trend of major faults. In Frame 20 the lineations corresponding to glacial movement are generally shorter (average of about 3 km) than the lineations relating to foliation. Otherwise the two types of lineations have a similar appearance. Both appear to be manifested by linear lakes.

The lineament along the western edge of Lake Tamiskaming (Orbit 911, Frame 18) is formed by a high-angle fault. This trend is represented by additional strong lineations west and northwest of Lake Tamiskaming and perhaps the fault along Harris and Pierre Lakes. In Frames 19 through 23 of Orbit 911,

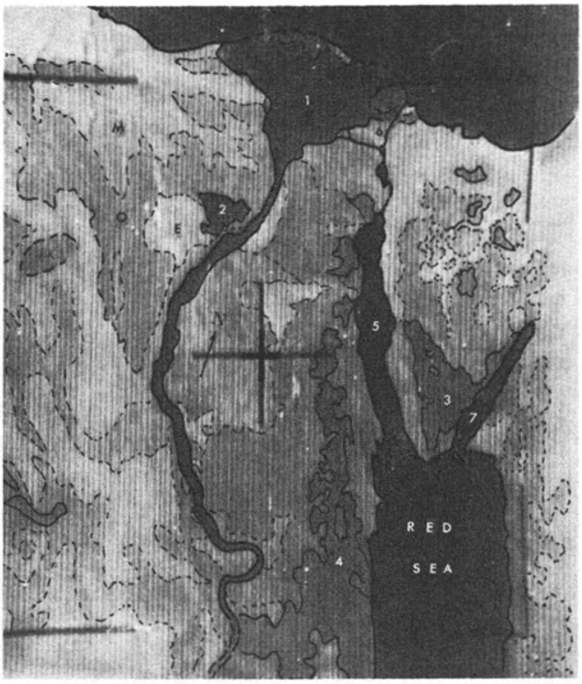

FIG. 5. Egypt including the delta and floodplain of the Nile, the El Faiyum Depression, light-toned Cenozoic deposits, and darker-toned pre-Permian igneous rocks. *Picture data:* TIROS V, Orbit 2, Camera 1 (wide angle), Frame 30, July 19, 1962, Low Oblique. *Key to locations:* (1) Nile Delta; (2) El Faiyum Depression; (3) Sinai Peninsula; (4) Red Sea Range; (5) Gulf of Suez; (6) Suez Canal; (7) Gulf of Aqaba. *Symbols: M*, Miocene; *O*, Oligocene; *E*, Eocene; *JK*; Jurassic-Cretaceous.

the most prominent trend is northeast to north-northeast, which is that of the glacial movement in this region. The great size of some of these features, such as Lake Roger (25 km. in length) makes it questionable that these are entirely glacial. A preglacial fault zone may have been excavated by the glaciers moving in essentially the same direction. The Tectonic Map of Canada does not indicate a fault trend in this direction; however, this area has not been mapped in detail.

In summary, there appear to be four prominent sets of lineations, the nature of which can be ascertained by available maps. Two sets were produced by Pleistocene ice movement. The north to north-northwest set displayed by Frames 15, 16 and 17 of Orbit 941 radiates from the Hudson Bay Region. The north-northeast trend seen on Frames 19 through 23 of Orbit 911 and Frame 20 of Orbit 941 radiates from Labrador. The other two lineations are tectonic in origin. The east-northeast trend appearing most prominently in Frames 18, 19 and 20 of Orbit 941 represents the system of fault zones which is roughly concentric to Hudson Bay. These faults are mostly thrust or reverse faults.

The north-northwest trend shown by Frame 15 of Orbit 941 and Frame 18 of Orbit 911 corresponds to the major system of faulting which forms a radial pattern emanating from the Hudson Bay Region. In general these are strike-slip faults.

Lineations produced by small finger lakes and snow-filled valleys have a similar appearance whether they represent tectonic or glacial trends. It does not seem possible to distinguish tectonic and glacial lineations with any assurance. However, one might speculate that very long lineaments (in the neighborhood of 25 km.) are at least in part due to faulting, folding or foliation, even though they may have been exaggerated by moving ice.

EGYPT

The quality of the photograph in Figure 5 is excellent for the TIROS system. Readily identified are the Red Sea on the right, bifurcating northward left into the Gulf of Suez and right into the Gulf of Aqaba. The Suez Canal can be seen connecting the Gulf of Suez and the Mediterranean Sea. The fertile delta and floodplain of the Nile River and the El Faiyum depression (2)—enriched by soil carried by Nile floods—appear dark

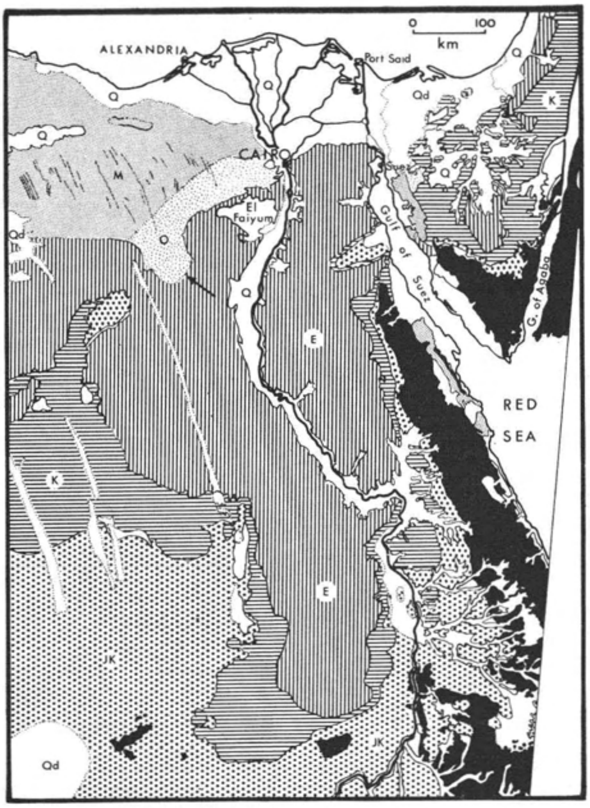

FIG. 6. Geologic Map of Egypt. (After "Carte Geologique Internationale de l'Afrique," Sheet 2, Ref. 1.) The map area is slightly larger than the coverage of Figure 5. *Explanation: Q*, recent and Pleistocene, undifferentiated alluvium, gravel terraces, coral reefs and raised beaches (no pattern); *Qd*, sand dunes (no pattern); *M*, Miocene—limestone, evaporites, sandstone; *O*, Oligocene—continental sandstone; *E*, Eocene—limestone; *K*, Cretaceous—limestone, marl; *JK*, undifferentiated Jurassic and Cretaceous-Nubian sandstone (mainly Cretaceous), marl, limestone (horizontal lines); Pre-Permian igneous and metamorphic rocks (solid black).

owing to the dense vegetation. The Nile River itself is not visible.

Many of the tonal patterns visible in the picture can be explained with reference to the geologic map, Figure 6. The dark area just west of the Red Sea (4) agrees fairly well with the dark-toned area on the map (Red Sea Range) consisting of Precambrian rocks, pre-Permian igneous rocks and flanking Jurassic and Cretaceous sediments. Similarly, the dark triangle on the southern Sinai Peninsula (between the gulfs of Suez and Agaba) agrees with outcrops of the pre-Permian igneous rocks. The dark areas also correspond to highlands; therefore, sparse vegetation may add to the dark tone. The light-toned fingers in the central Sinai Peninsula are alluvial valleys.

With reference to the geologic map, the Eocene-Oligocene* contact trends southwestward from Cairo along the north edge of the El Faiyum depression. This contact appears on the photo as a tone difference with Eocene lighter and Oligocene darker. On the map the Oligocene forms a neck-shaped outcrop southwest of the El Faiyum depression. The neck is truncated by a dotted line (see arrow), which symbolizes an imprecise geologic contact. The TIROS picture, however, suggests that the contact continues southward in the shape of a spear; and indeed, the more recent geologic map published in Ref. 7, Figure 2, shows the contact precisely the way the TIROS picture suggests. The dark spot west of the spear-shaped area corresponds to Jurassic-Cretaceous exposures of the map. Many of the other markings on the photograph are not directly explainable by the map. But it should be noted that the map delineates time-rock units rather than rock units and therefore it is not entirely suitable for comparison with the photographs.

With regard to structural features in the

* The Oligocene referred to here is assigned to the Miocene in Ref. 7, Figure 2.

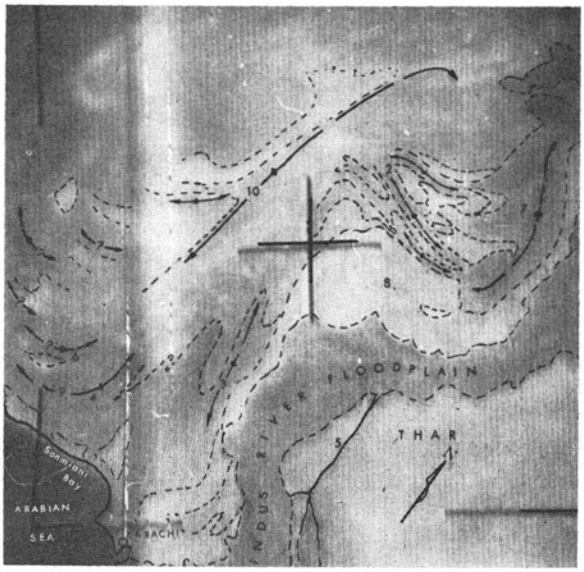

FIG. 7. Pakistan showing the Indus River floodplain, Thar Desert, and fold mountains. *Picture data:* TIROS V, Orbit 1487, Camera 2 (wide angle), Frame 32, September 1962, Low Oblique. *Key to Locations:* (1) Cape Monze; (2) Cenozoic Mountains; (3) Kirthar Range; (4) Makran Range (?); (5) Nara Canal; (6) Siahan Range (?); (7) Sulaiman Range; (8) Tertiary and Pleistocene sediments, (9) West Punjab; (10) Afghanistan-Pakistan border ranges.

region photographed, the straightness of the coastlines of the Red Sea and the Gulf of Aqaba prompt the interpretation that they are controlled by faulting. The Red Sea area is part of the northwest-trending branch of the African rift system. The other branch trends northeastward paralleling the southeast coast of Saudi Arabia.

PAKISTAN

Most of Pakistan as well as a part of northwestern India and all of Afghanistan are shown in Figure 7. The central cross is in the province of Baluchistan at approximately latitude 29°N, longitude 67° E. Several prominent geographic features can be identified readily. The Indus River floodplain forms a medium-gray band across the lower part of the picture northward from the Arabian Sea. The cultivated floodplain contrasts with the less vegetated bordering regions, which create a lighter tone. The Indus River itself is not visible. To the east of the floodplain is the Thar, or Indian Desert. The lighter tone of the desert is explained by the barren alluvium and sand dunes that cover its surface. The Nara Canal (5) appears as a thin line crossing the edge of the Thar Desert. The southern coastline of Pakistan is clearly delineated in the lower lefthand corner of the picture. Cape Monze is at (1).

The sweeping curvilinear tonal pattern west of the Indus River is the most striking feature of the picture. The pattern is created by the geologic structure of the mountainous region of west Pakistan. In the majority of the cases it appears that the light areas correspond to barren alluvial valleys and the dark areas to linear mountain ranges. For example, (7) is the location of the Sulaiman Range and (3) marks the general area of the Kirthar Range. Location (10) probably marks the trend of the ranges along the border between Pakistan and Afghanistan. The queried symbols, such as (4) and (6) locate the general position of other ranges where it could not be ascertained that these dark areas actually are ranges.

An attempt has been made to map the major tonal contacts. A close correspondence between the photograph and the geologic map in Figure 8 does not exist; however, tonal changes are not expected to be equivalent to time-rock units. Nevertheless, the darker areas around (7) and (3) agree roughly with the Jurassic and Cretaceous limestones of the map (symbol J–K). In addition, many of the light bands agree with the boundaries of valleys shown on relief maps of Pakistan.

The tonal mapping reveals some gross structural aspects of the region. The form of the contacts suggests long curved folds of the alpine type in the region west of the Indus River. This structure resulted from the Ter-

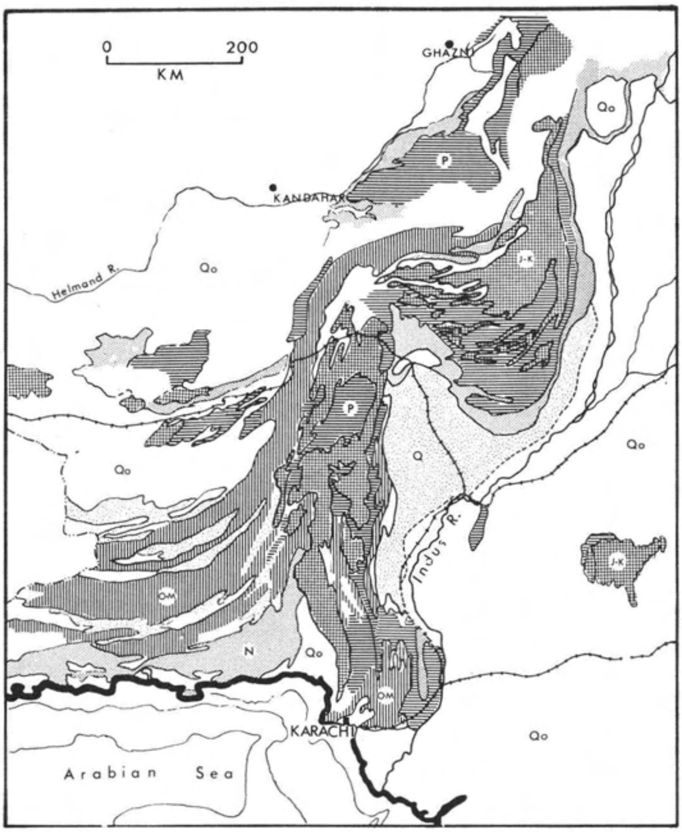

FIG. 8. Geologic Map of Pakistan. (After "Geologic Map of Asia and the Far East," Ref. 3.) The map shows approximate area of coverage of Figure 7. Afghanistan occupies the left part of the map, Pakistan the center, India the lower right corner. *Explanation: Q*, Recent—alluvium, terrace, and sand dune deposits; *Qo*, Pleistocene—older alluvium, terrace deposits; *N*, Neogene marine and freshwater sediments; *O–M*, Oligocene and Miocene—marine and continental sediments; *P*, Paleogene—marine sediments; *J–K*, Jurassic and Cretaceous—volcanics, coal-bearing rocks, limestones.

tiary orogeny which effected the entire Alpine-Himalayan belt. The Thar Desert does not possess this pattern; it belongs to the stable craton of India which was not involved in Tertiary deformation.

Conclusions

From the foregoing analysis it is possible to define within broad limits the nature of terrain information recorded in TIROS pictures. Markings are produced where two large areas with widely varying albedos are contiguous, and detail is effectively masked by a rather complete cover of vegetation. Snow and ice, however, may reveal drainage patterns and tectonic and glacial lineaments in vegetated areas. It is likely that winter views from TIROS of poorly known regions in the high latitudes could contribute worthwhile information to the structural geologist and glaciologist.

Aside from the winter pictures of Canada, the only TIROS pictures that show significant ground detail are those of arid or semiarid lands. This is largely because unvegetated alluvium (generally sand or gravel) has a high reflectivity and contrasts sharply with darker outcrop. By mapping the alluvium-outcrop boundaries some gross structural patterns are disclosed, for example, the major trend of mountain ranges. Parallel and sinuous ranges are probably of the alpine or fold type, such as in western Pakistan, whereas rectilinear trends are more likely of the fault-block type, such as the Basin and Range Province of the western United States.

There is no true indication of relief in TIROS pictures. A false indication is created in desert regions where the darker areas are expected to be highlands and the light areas alluvial basins. The darker tone of the mountains is presumably due to the rugged, sha-

TABLE 1

EASILY IDENTIFIABLE FEATURES

Feature	*Identification Criteria*
1. Large bodies of water	Darkest land features, black tone, uniform texture, sharp outline.
2. Large floodplains and deltas	Dark tone owing to vegetation. Floodplains follow sinuous paths terminating at large bodies of water. Deltas have triangular shape with base forming shoreline.
3. Shoreline beaches and barrier beaches	High albedo, occur on or parallel to shoreline.
4. Desert sand seas and bolsons	High albedo, circular or elongate shape, associated with playas and dunes.
5. Playas and barred evaporite basins	Brightest land features, albedo comparable with clouds. Playas occur within bolsons, barred basins occur adjacent to large bodies of water.
6. Giant seif dunes (greater than 50 km. in length)	High albedo, gently curved, long and narrow shape, associated with sand seas.
7. Cenozoic Orogenic belts in arid or semi-arid regions	Bands of parallel dark and light streaks, usually curved or sinuous.

dow-trapping topography, dark rock outcrops and some vegetation. But the only important criterion for the recognition of high elevation is the existence of persistent cloud formations.

Only a few features are unequivocally identifiable in a terrestrial TIROS picture without prior knowledge of the area photographed. These are features that have unusually distinctive tone, texture, associations or shapes; they are listed in Table 1.

In addition to the features listed in Table 1, other features can be identified under ideal conditions. Major lineaments are identifiable if they separate highly contrasting surfaces. For example, the San Andreas fault separates the Mojave Desert from the Transverse Ranges of southern California and the Salton Sink from uplands to the east. Or, highlands along the lineament may contrast with the surroundings owing to greater vegetation cover. This is the case with the Zuni lineament of the Colorado Plateau. On the other hand, lineaments in southeastern Canada are manifested by the alignment of elongate, frozen lakes.

Major circular structures covering areas on the order of thousands of square kilometers may show up in TIROS pictures. The Colorado Plateau, for example, is outlined by wooded highlands which appear dark in comparison with the Plateau proper.

Rarely are bedrock formation contacts resolved by TIROS. Highly contrasting units whose outcrops cover extensive areas can be mapped in parts of the Sahara Desert and to a lesser degree in the Middle East and southern Asia. In most cases, however, individual units cover areas smaller than the resolution of the camera system, or are masked by vegetation.

The study has also disclosed some of the more common pitfalls the interpreter is likely to encounter. Vegetation produces one of the more perplexing problems because, depending upon the density of vegetation cover, all tones of light to medium gray and all textures can be produced by vegetation. It seems impossible to identify vegetation from the photographs alone. Heavily vegetated areas cannot be distinguished from dark rock outcrop, and light material with a sparse vegetation cover may have the same appearance as outcrop of intermediate gray tone. Secondly, snow, ice, clouds and playas display similar tone and texture. The distinction of these features may rely on their persistence for long periods, their associations and relation to other features, and their shape and border sharpness.

Care must be exercised in interpreting tonal changes bordered by the raster lines, because electronic distortions commonly create false bright and dark areas parallel with the scanning direction.

There is no question that satellite video systems have promise in terrain analysis.

Even the TIROS system (although designed only for meteorological purposes) records a significant amount of terrain information. Since TIROS pictures furnish insight into the kind of terrain information resolvable by space television systems, their study provides a firmer basis for interpreting video pictures of other planetary surfaces with comparable scale and resolution.

ACKNOWLEDGMENTS

The authors are grateful to Dr. Paul D. Lowman Jr. and Mr. Paul Heil, Goddard Space Flight Center, and Lester F. Hubert, U. S. Weather Bureau, for their aid in the acquisition of the TIROS pictures. Mr. Herbert G. Adams, Geology Department, University of California, Los Angeles, prepared the TIROS II mosaic of southeastern Canada and collaborated with the authors on the interpretation of the mosaic. The study, supported by NASA Contract 5-3390 and the Lockheed-California Company, is ported in more complete form in Reference 6.

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Obituary

Prof. H. L. Cameron

Prof. H. L. Cameron, head of the Geology Department at Acadia University, Wolfville, Nova Scotia, Canada, recently died at the age of 53 following heart surgery.

He is particularly well remembered by his fellow members of the American Society of Photogrammetry as a frequent active participant for some twenty years at the annual conventions of the Society. He was the director of the photogrammetry division of the Nova Scotia Research Foundation and became an authority on the application of high altitude aerial photography.

In addition to photogrammetric topics, he published numerous papers in the fields of geology, archeology, and hydrology. For the past two years he has directed research under a contract with the U. S. National Aeronautic and Space Administration. He also conducted projects for Canada's National Research Council and Defense Research Board.

Professor Cameron was sought as a speaker at scientific conventions in his fields. Not only did his papers contain valuable information, but also he presented the material in a manner that was easily understood and *enjoyed*. He employed his keen sense of wit as widely on the rostrum as on less formal occasions.