AIRPHOTOS

ILLUSTRATING

THE ORIGIN, DISTRIBUTION, AND AIRPHOTO IDENTIFICATION OF UNITED STATES SOILS

Appendix B

of

Preliminary Technical Development Report No. 52

1946

U. S DEPARTMENT OF COMMERCE

CIVIL AERONAUTICS ADMINISTRATION

WASHINGTON, D. C

1306

APPENDIX B

The aerial photographs contained in this appendix illustrate the airphoto techniques for identifying soils which are described in Chapters VIII to XIII, and in the airphoto identification chart, of the parent publication entitled "The Origin, Distribution, and Airphoto Identification of United States Soils," Technical Development Report No 52, and form a part of that publication As they are referenced to the text of that publication, in which they are fully discussed, any effort to utilize them for airphoto analysis of soils with no more explanation than the captions shown on each plate and without the full text, is certain to fail, and should not be attempted

Many of the illustrations consist of matched pairs of adjacent airphotos, so placed as to enable the reader to obtain from them an optical reception of the third, or vertical, dimension This can be done by use of a stereoscopic viewer, many types of which are available commercially from various manufacturers of optical equipment, lenses, and other instruments Some of the simpler types of these viewers have been available in the past at very nominal cost With a little practice certain individuals find it possible to view the matched pairs of photos stereoscopically with the naked eye by merely focusing the vision at a great distance

The airphoto soil identification technique does not depend entirely upon the use of stereoscopic coverage, as color, drainage pattern, certain erosion patterns, vegetation, land use, and even certain land forms, all of which are the keys to airphoto interpretation, are often discernible on the single photos and county index sheets Therefore, although the reader may not have immediate access to stereo viewers, he can, in some localities, apply many of the principles of airphoto interpretation with good results

Within limitations of security regulations aerial photographic index sheets and contact prints may be purchased, at nominal cost, from the government agency which has the photographic negatives Several commercial firms also sell these photographs, and some states maintain files of certain areas Of the government bureaus, the Agricultural Adjustment Agency has a large majority of all airphotos of the country The Forest Service, Soil Conservation Service, Geological Survey, Tennessee Valley Authority, Bureau of Reclamation, Coast and Geodetic Survey, War Department, and others, also have photographs of parts of the United States Whenever possible orders should be addressed to the bureau which has the negatives from which reproductions are desired Index sheets may be ordered by description of the area or by reference to a map Contact prints must be identified by designating the alphabetical symbol and the numbers, which are obtained by reference to the county index sheet Orders may be taken by local offices of some of the Federal agencies possessing the negatives If the information desired cannot be obtained locally or if it is not known which bureau has the film, orders or inquiries should be addressed to the Office of Plant and Operations, Department of Agriculture, Washington 25, D C The Civil Aeronautics Administration has a number of aerial photographic county index sheets and contact prints, and will furnish such information on these as it possesses, in addition to giving information as to the source of airphotos

For security reasons the airphotos here published are without identification as to their exact location

List of Plates

The scale of all airphotos except Plate 16 and Plate 23B is approximately 2½ to 3 inches equals one mile The scale of Plate 23B is approximately 5½ inches equals one mile, and that of Plate 16 about 4 inches to the mile

Plate 2. Stereopair of the Connecticut valley showing intrusive (Triassic) "trap rock" ridges protruding above the surrounding glacial terraces. The white areas are tobacco fields covered with white net canopy. A drumlin is also visible.

Plate 3. An aerial view of scablands showing exposed basaltic bedrock covered in intermittent areas by streaks of wind blown silt. The channel scar, now filled with trees because of favorable moisture conditions, is not necessarily typical of scablands.

Plate 4. An airphoto of an area of moderate relief showing the contrasting soil patterns in adjacent young and old drift.

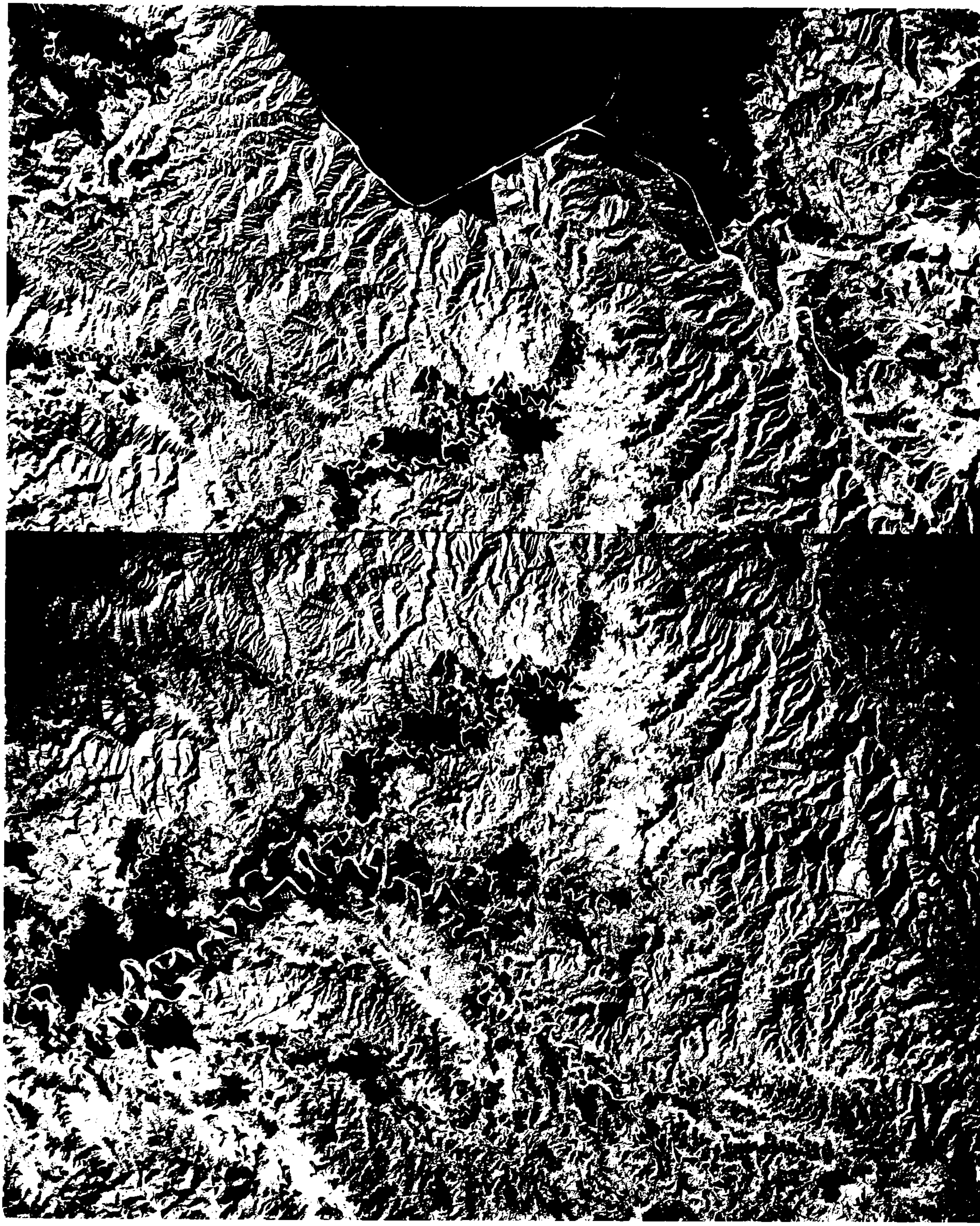


Plate 5. This example of badland topography amply illustrates the motive for considering these landforms as non-soil areas. Not only lack of vegetative cover and intense rainfall but lack of cohesion between particles accounts for this complete dissection.

Plate 6. Erosion typical of sandy silts and sandy clays having a high percentage of sand. These long narrow gullies have a U-shape, and are cutting through the weathered profile. Angularity in their courses is a result of farm practices rather than of soil or parent rock.

Plate 7. These gullies occurring in deep loess possess the fins that remain as a result of protection by vegetative cover and the type of headward progress found in these silt materials.

Plate 8. A gully form occurring in a plastic lakebed (lacustrine) soil showing the uncontrolled meanders and the extensive channel.

Plate 9. This aerial view of tilted sedimentary rocks shows recurring beds of shale centered around a sandstone-capped ridge. The river on the left of the ridge has cut a valley in soft shale as has the small stream on the right of the ridge. In the upper portion of the illustration a stream flows through a deep gap cut in the ridge. The intricate dissection typical of clay shales has etched the weak strata exposing the land form of tilted shales. The individual shale hills tend to form minor ridges paralleling the principal ridge. The two opposite-facing slopes characteristic of all these ridges are unlike; those facing the upper left are longer and less abrupt than those facing the lower right. The steep slopes are those cutting across the bedding planes of the rock.

It can be seen that the alluvial soils are most satisfactory for agricultural use; only isolated fields occupy the more gentle slopes of the residual areas where shales form the bedrock. The rounded sandstone crest is being prepared as an orchard, with young trees forming the regular pattern.

In these soil areas the profiles developed from the rock are shallow and largely insignificant in construction work. Except in special instances even slight cuts will be made in rock. Whether excavation is in soft shale or massive sandstone or wet unstable colluvial material can be determined by the slope and amount of dissection that distinguishes these materials. Even the most economical direction for operating earth-moving equipment can be pre-determined.

Plate 10. This stereopair contains an excellent example of a dissected area of nearly horizontal sandstone (Dakota) and shale (Purgatoire). The valley shapes, both in plan and in cross section are typically those of flat-lying sandstones and shales. Inspection shows the definite line of outcrop of the resistant sandstone as opposed to the sloping portions of the hillsides where the clay shale is exposed to weathering. For contrast compare the crescent-shaped outline of these valleys with the angular appearance of dissected limestone in Plate 13.

Plate 11. A stereopair showing nearly horizontal sandstones and clay shales along the upper Ohio River. In this area the climate is favorable to crops and settlement. Here the land form is emphasized by the land-use pattern; the sloping sections which are shale outcrops are cultivated while the abrupt slopes marking the sandstone ledges are forested.

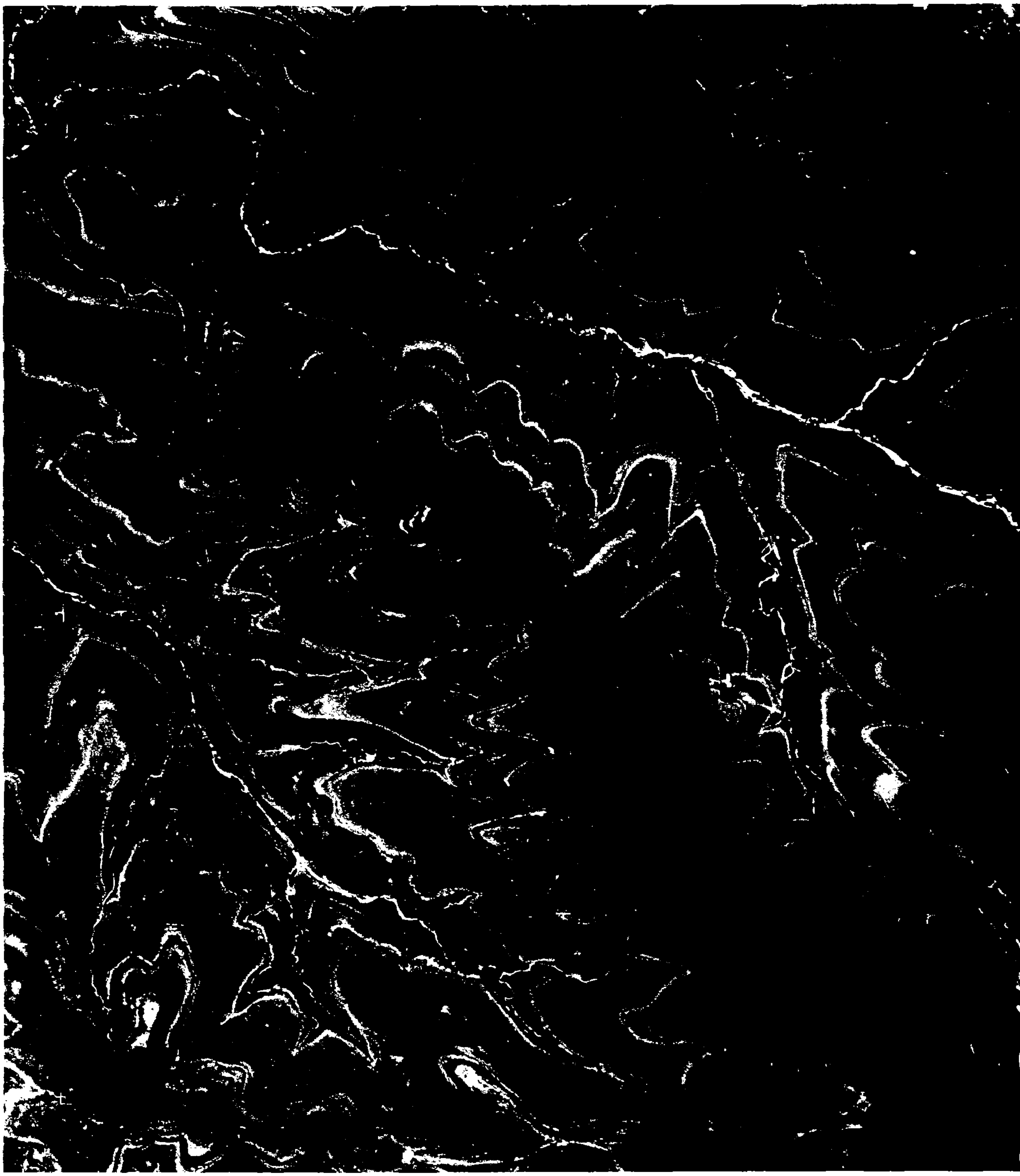


Plate 12. This west-central area containing cherty limestone, clay shale, and some sandstone has the appearance of a naturally developed contour map. Undisturbed by uplift the exposed outcrops follow an almost constant elevation. The harsh beds of chert are comparatively resistant and form the narrow white bands that mark the outcrop. The easily weathered shale assumes low slopes and appears as broad dark bands. On the original print the presence of chert can be observed. See also Plate 16.

Plate 13. This stereopair illustrating the topographic drainage and sinkhole characteristics of a moderately dissected limestone area also shows the typical valley shapes and sections. In comparing this with Plate 10 the sharp intersection angles of valley walls and the lack of modification of valley walls by surface runoff present a sharp contrast to the rounded slopes and intersections observable in sandstone and shale mixtures.

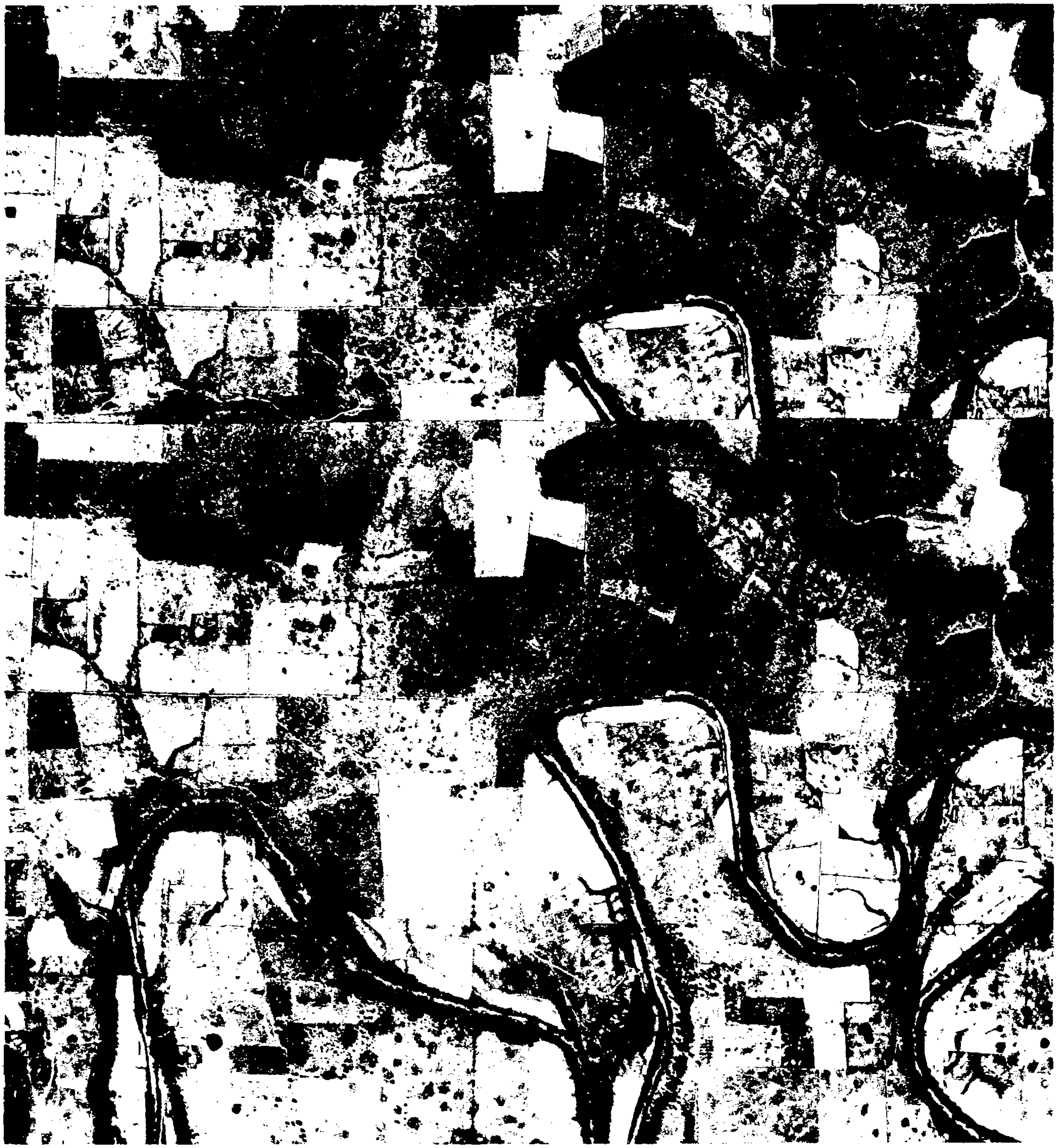


Plate 14. The site purposely chosen is complicated somewhat by the presence of sandy shale hills that are distinguished by forest cover, very active erosion, steep slopes, and an absence of sinkholes. Where the limestones have been exposed there is an abundance of sinks, many of which are sufficiently abrupt to cause erosion on the side slopes. These soils are of sufficient depth (5-10 ft.) that only minor rock excavation is necessary for normal grade requirements. A large proportion of the sinkholes are free draining and therefore require particular treatment for capping and backfilling. Fortunately, these also provide discharge points for accumulated surface runoff, thus reducing the expenses of drainage installations. The soil mantle on the shale hills is shallow and contains much higher proportions of sand and silt than the associated limestone soils. The significant internal drainage in limestone is visible here. The large stream that has cut a narrow valley in the limestone has only a few minor tributaries and these drain the shale areas.

Plate 15. This vertical photograph of tilted dolomitic limestone, in conjunction with Fig. 79, illustrates the relative durability of dolomitic limestone over the more soluble types. The lack of significant soil cover evident in the ground view accounts for the fine detail of bedding visible in the vertical. This complex area contains (A) metamorphosed rock; (B) steeply dipping, thinbedded, dolomitic limestone; and (C) nearly horizontal, massive ledges of cherty limestone.

The comparative influence of tilted and horizontal strata on the drainage pattern can be observed in B and C.

Plate 16. An air view of a cherty limestone region. The presence of scattered sinkholes and the obvious "limestone valley" identify this as an area of residual soils developed from limestone. In further detail the numerous circular white dots that appear in many fields indicate the presence of a high percentage of chert fragments in the soil profile.

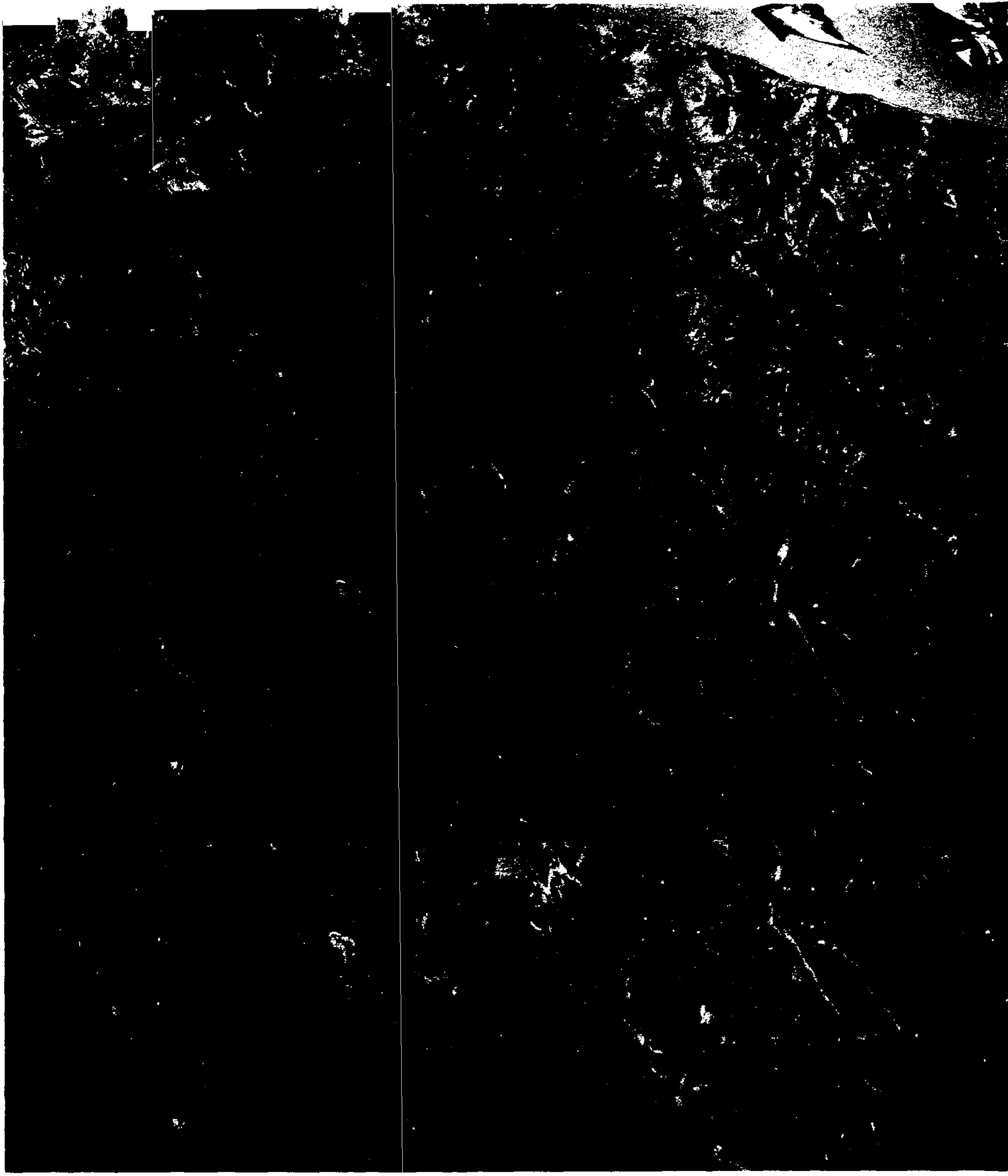


Plate 17. A stereopair showing clay shale (Pierre) exposed along the Missouri River. The soft, rounded slopes and the highly developed drainage system are evidence of the fine texture of the soil and the imperviousness of the profile. The unusual depth and uniformity of the clay shale can be observed by an examination of the hillside slopes that reveals only minor strata of sandy shales near the base of the hills at the river. Because of its proximity to the river this area is more deeply dissected than typical.

Plate 18. A clay shale area in one of the arid western states illustrates the fact that climatic differences do not normally alter the basic pattern that is contingent upon physical properties of the rock rather than the amount of rainfall. The intr'cate pattern of the drainage system betrays the imperviousness of the clay shale, the gentle gradients of the drainage ways and the unbroken smoothness of the hills is evidence of cohesive materials. The diagonal line crossing the lower left corner is an active fault. The possibility of future movement along this line should enter into the consideration of every engineering structure associated with this area.

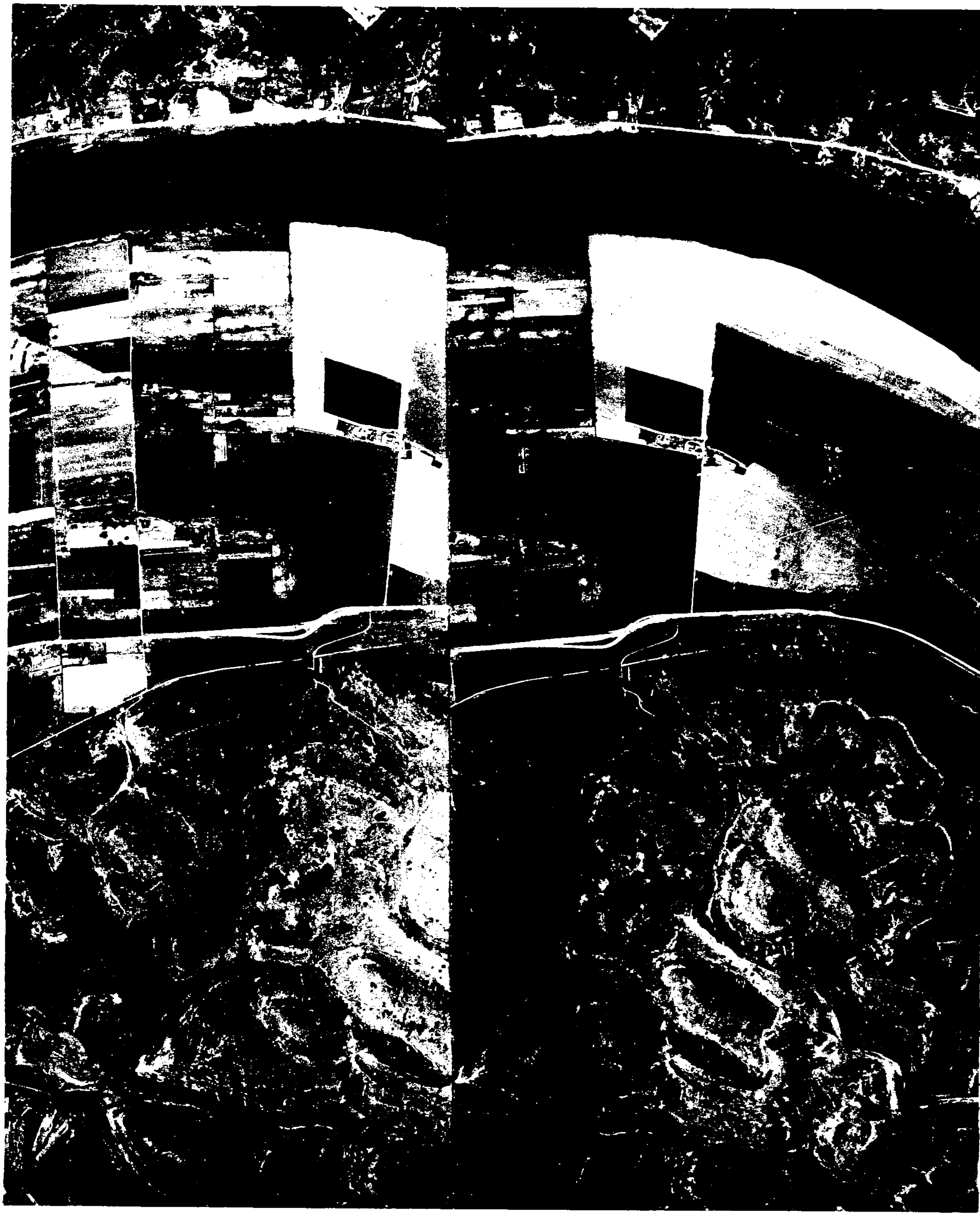


Plate 19. This photograph shows a land-form pattern of materials that are preponderantly shales although necessarily mapped on Plate 1 as Shales and Sandstones. Nearby, the hills are capped with sandstone that when removed by erosion, as has occurred here, will slowly assume the form of shale hills. These materials are subject to landslides.

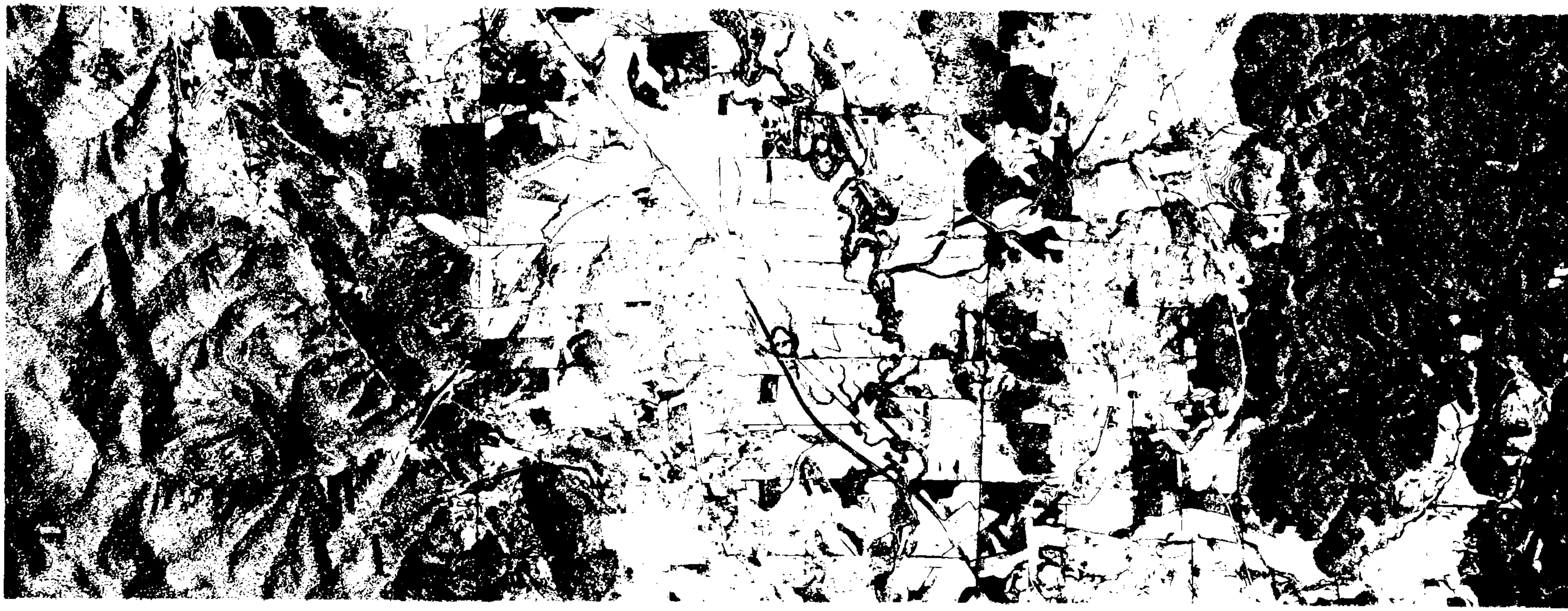


Plate 20. This section across a valley in the southeastern states presents a remarkable contrast in adjacent land forms. On the right the forest cover on the harsh hills of the highly dissected slate tells the story of its shallow infertile profile. The central valley is cut in limestone while parallel ridges of upturned sandstone and shale form the valley wall on the left. The rock mass in the upper left is a quartzite that has uplifted to distort the adjacent sedimentary beds.

Plate 21. This view shows the pattern produced by the weathering and land use of schists and associated rocks. The intricate and detailed pattern of agricultural terracing is apparent in all cultivated fields. Other than the unique land form the color pattern is the most salient element. The soils having high clay content appear dark while the more sandy areas are proportionately light.

Plate 22

Plate 22. The land form is identified by the circular pattern and the sequence of rock types emerging from relatively level, transported materials. The partially forested area of high relief and well developed dissection is a core of granitic rock. The origin of this material is indicated by the presence of a broken layer of sedimentary rock forming a contact line between the intrusive material and the lower plains. At several points around the circumference of the intrusion, the runoff from the granite slopes has cut through the sedimentary rocks fringing the base of the mountain. The fact that the material in the body of the intrusion occurs in this form restricts its origin to that of an igneous rock, while the sedimentary rocks surrounding the intrusion may be identified by stereo-examination of the weathered faces that reveals traces of layering or stratification. The "plains" material in the terraces immediately at the base of the mountain is composed chiefly of material weathered from the core; the sedimentary rock which originally covered the granite represents a very small portion of the weathered material. In addition, the steeply dipping strata probably extend some distance beneath the surface and, therefore, do not contribute materially to the soils on the lowlands. The evidence of material being transported from the rough residual section substantiates this in that the streams appear to reach a well established gradient soon after leaving the rock area and are therefore depositing their sediments near the base of the slopes. The soils of the level area are granular, being derived principally from the weathering of the granite and being distributed by water flowing from the steep slopes.

In viewing these pictures stereoscopically, it will be seen that the stream issuing from the hills near the left edge of the picture is cutting through its original alluvial deposit and has left several terraces marking various stages of dissection. Surrounding the base of the mountain and extending out a distance of approximately one mile, granular terraces extend outward and parallel to the streams. The gullying on the right indicates materials that are possibly silty and sandy in texture, since there is some evidence of surface drainage developing. All the gullies are of a simple form and have a V-shape indicating a semi-granular material.

Referring to the intrusion, it is obvious that this igneous form of rock cannot be classified as volcanic; on the other hand it can be definitely identified as a material that has cooled beneath the surface of the earth, at least to the point that it has formed a definite mass that will retain its structural properties after exposure. Had this material been of volcanic origin, it would have developed a flow pattern. Material in the liquid form issues from the interior of the earth and assumes an unmistakable pattern on flowing downhill to fill valleys and depressions.

Plate 23a

Plate 23b

Plate 23. (a) Stereopair showing the normal relief and pattern of the granites in the eastern Piedmont and (b) a section showing the noticeably darker tones associated with those granite soils having a high clay content. (Scale of (b) only is $5\frac{1}{2}''$ = 1 mile.)

Plate 24. This stereopair illustrates the distinctive appearance of the land form typical of granites in many areas. The rounded hills imply a uniformity of the rock material that is not duplicated in other types. Some slight movement has resulted in fractures that created a lineal development and oriented the lakes along somewhat parallel axes.

Plate 25. The exposed basalts of Washington, while assuming the expected land form, have undergone such unusual conditions in recent geologic time that they cannot otherwise be considered typical. Glacial scouring, minor faulting, and partial cover by loess adds to the unique appearance of this stereopair. Even in this remote deposit the loess has developed the land form pattern of parallel hills.

Plate 26. The area covered by this stereopair of photographs includes portions of a wide alluvial plain and a series of source-bordering loess ridges. Although the crests of the ridges are irregular, the parallelism of the principal axes of the hills can be readily observed. The relatively sharp crests of these ridges, the spacing between crests, and the magnitude of the relief are characteristic of these deposits near the source.

The irregularities in the crests can be attributed to local conditions. The alluvial area represents two terraces; one high, and one that is even now occasionally inundated (note current scars). At different times these two areas reached optimum conditions for scouring by the wind; therefore, a slight shifting of the source area has slightly complicated the basic pattern.

Erosion, in an active sense, is of minor concern here. The material is deep and relatively porous and absorbs the rainfall to a large degree. The slopes in much of the area have proven too steep for cultivation so that much of the area is protected by a cover of brush and second growth. Water is difficult to obtain in these hills and clearing involves the blasting of stumps having deep tap roots. No rock would be encountered in highway cuts and grading would be confined to the one type of soil. See Fig. 32.

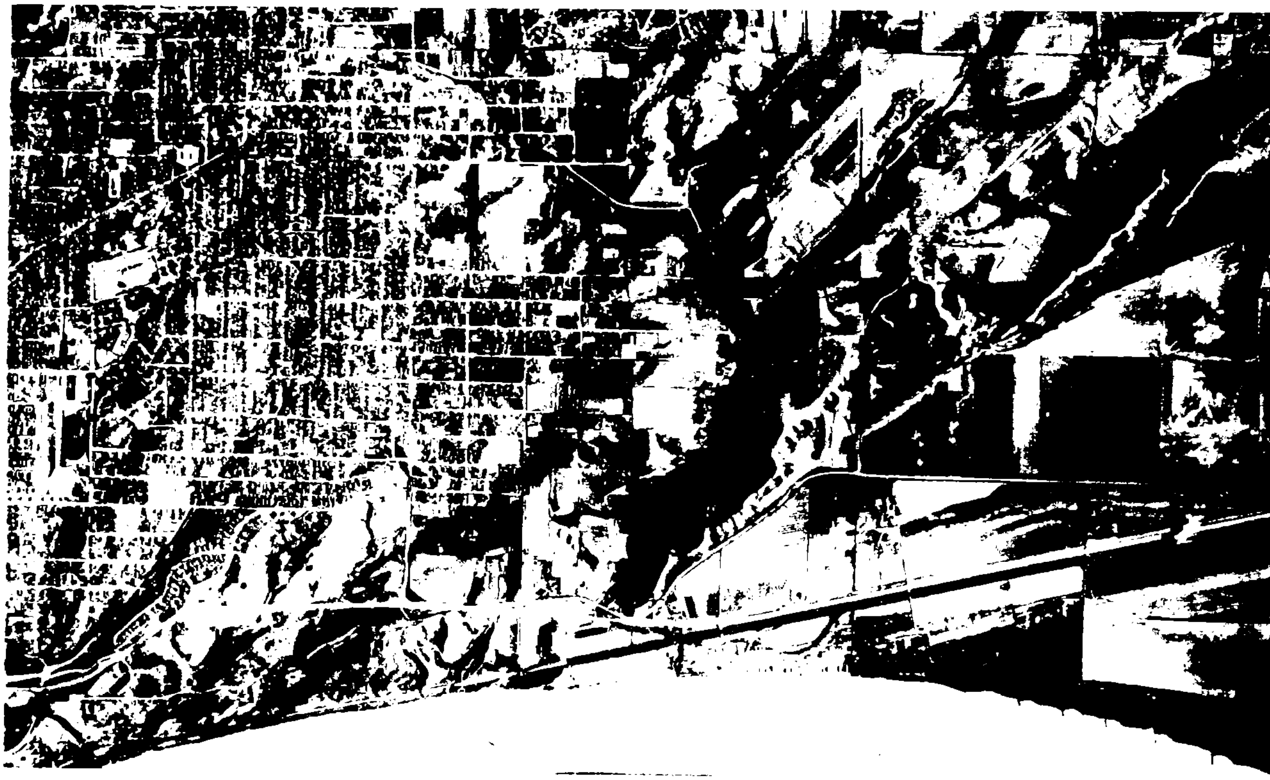


Plate 27. The two sections of this plate illustrate the land form pattern of other loess areas in the Mississippi-Missouri River belts. In each there can be seen the alluvial areas that furnished the materials picked up by the wind and deposited nearby. The parallel hills oriented cross-wind again produce the related drainage pattern. A few instances of the outline of gullies in the loess can be seen along the face of the hills bordering the alluvial plains.

Plate 28. These patterns show that at distances somewhat removed from the source the ridges become more modified in form but retain their characteristics of parallelism and slope. Even when the differences in relief are as low as 10 to 15 feet, the regularity of the land form and the emphasis given by the primary drainage system produce the patterns shown.

Plate 29. Excessive erosion has almost completed the dissection of this loess area in Nebraska. The drainage pattern is emphasized by the deep cutting of the eroded channels. Here the long, parallel central channels formed between the loess ridges and the short, right-angled tributaries are more clearly defined than in many humid areas. The fin-like projections that are common in gullies eroding in this material can be seen in many of the tributaries.

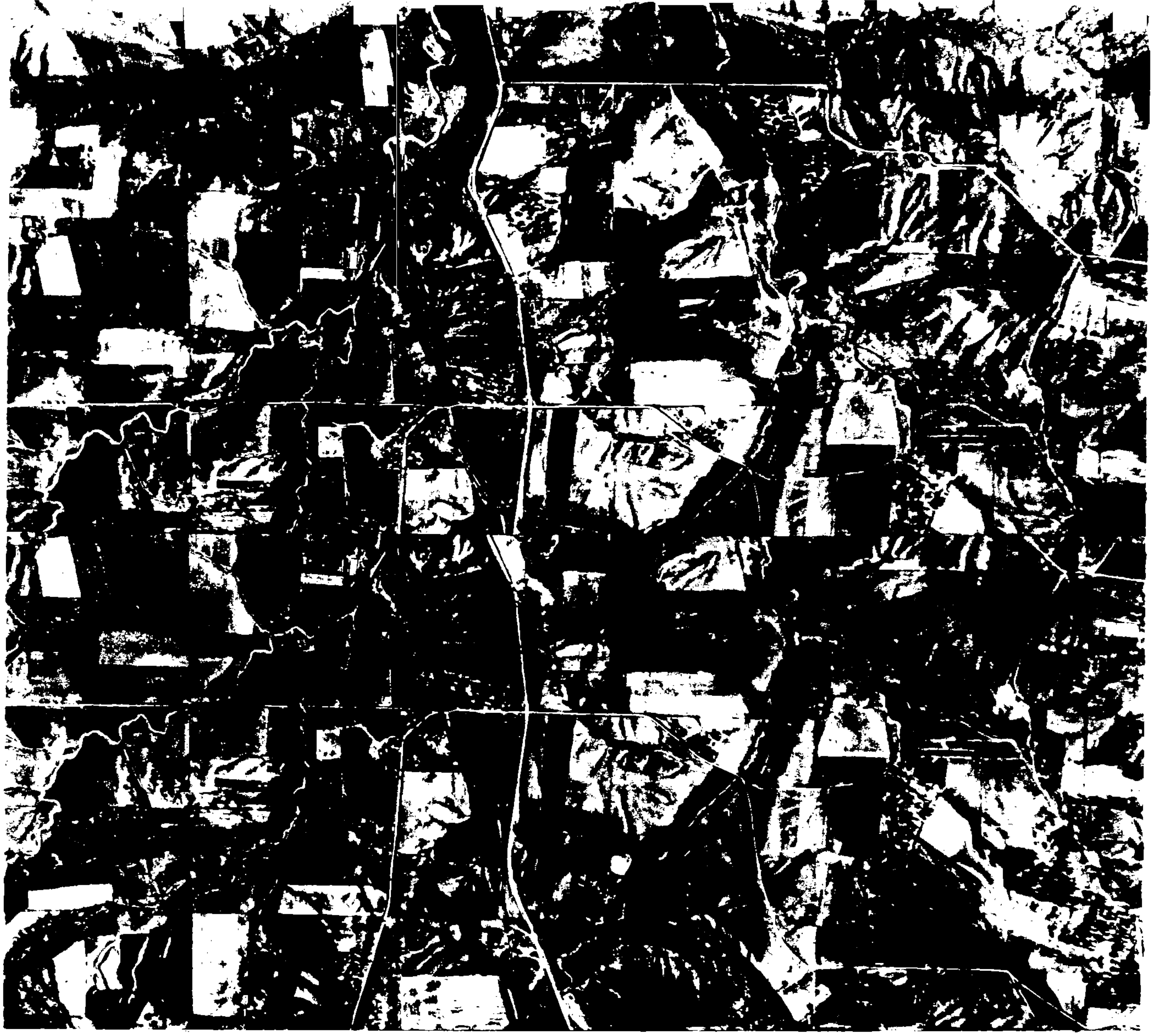


Plate 30. In many instances the loess has been deposited over an area of rough topography. Where the topography is sufficiently rough, the loess mantle modifies but does not obscure the land form of the underlying material. In such instances the land form that distinguishes loess may be either interrupted or entirely absent. A typical area of this kind is centered around Dubuque, Iowa. The illustration, taken from this area, shows a mature limestone topography mantled with as much as 30 feet of silt that overlies deep profiles of plastic red soil developed by the weathering of limestone.

Stereoscopic examination of these photographs reveals variation in slopes on the hillsides, indicating the presence of a bedrock; in fact, rock can be seen in the highway cuts. The amount and type of surface drainage developed on the slopes also indicates unusual conditions. The larger gullies, which are flat to gently rounded in shape are typical of silty-clay soil and indicate that the weathering of the loess has advanced into the B horizon (see Figs. 70, 71).

In areas such as these, or in other "transition areas," interpretation must be based on those elements of the soil pattern that deal with color response to drainage, slopes, and the extent and kind of gullies. For example, in this illustration it is readily observed that the gullies disappear near the base of the slope where the water can infiltrate into the more porous soil.

Plate 31. A stereopair illustrating a stabilized dune of the barchane form. The lack of natural surface drainage and uniformity of the color pattern indicate that not only the dune but the flat outwash plain as well, consist of sand.

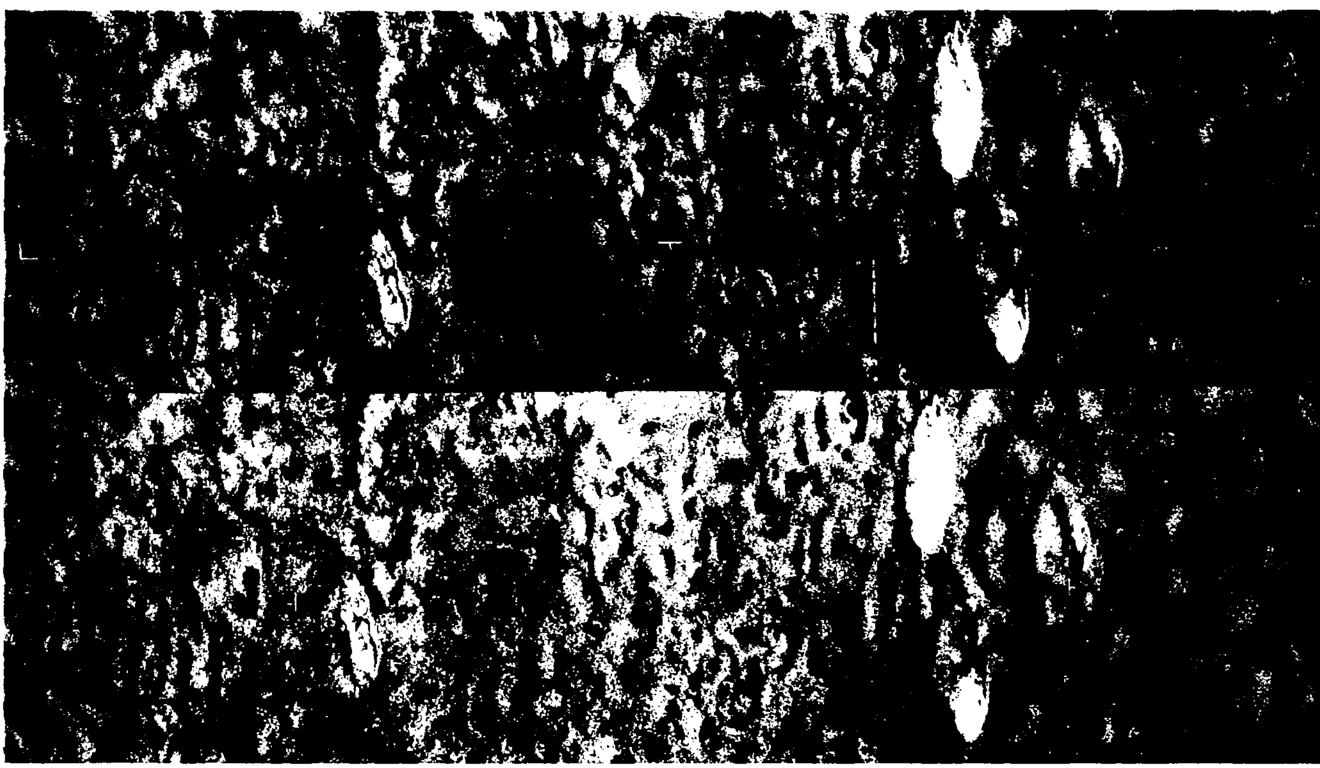


Plate 32. A stereopair showing an area of deep sand having surface features reworked by the wind. The dark spots are depressions with an accumulation of vegetation that is sparse on the higher hillsides. Individual clumps of sage and grass can be seen by close inspection. The white areas are "blowouts" where the sand is now drifting to form new dunes.

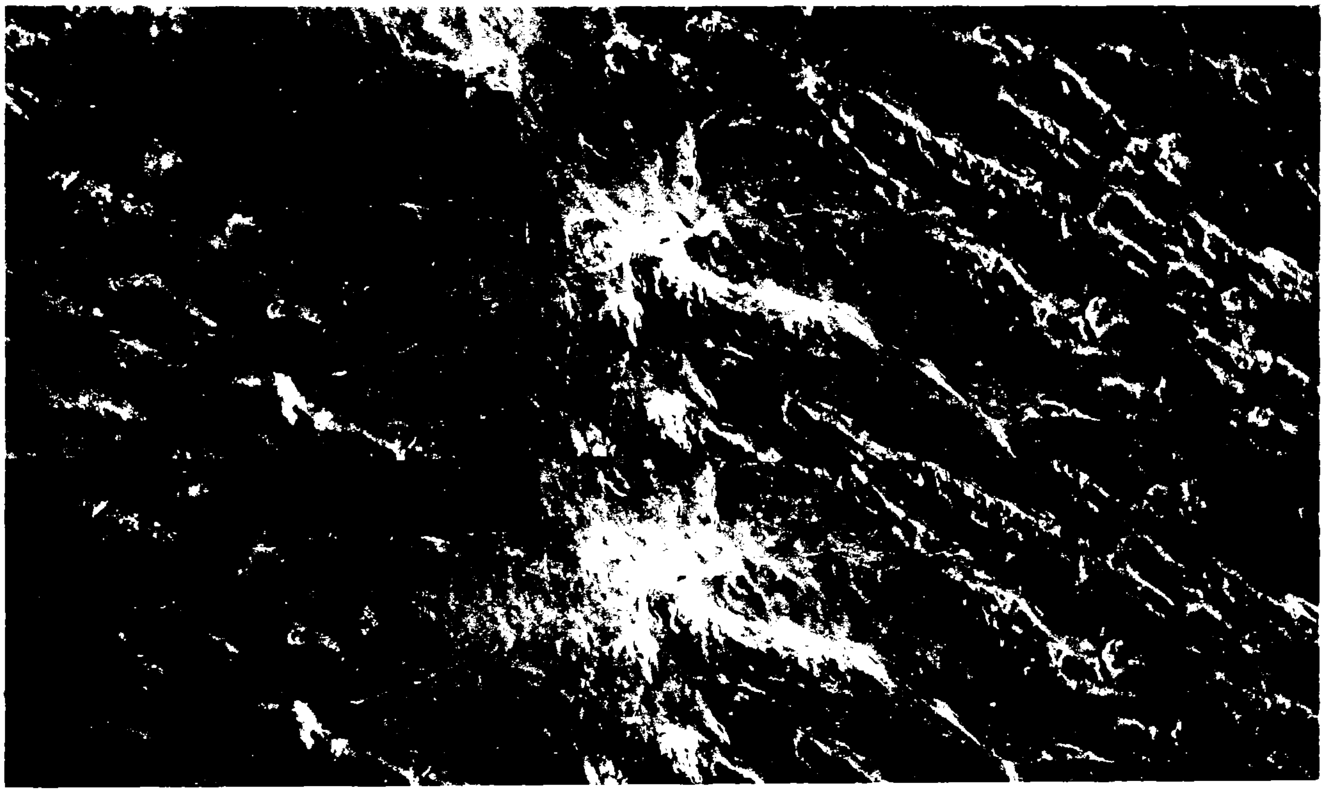


Plate 33. An unusual land form consisting of double crested, barshaped dunes. The elevated trough lying betweer the crests has been divided into cells by more recent winds that are blowing in a direction some 35 degrees fron that of the winds which formed the original dunes. This is not an area of deep sand since surface drainage can be observed nearby and a water hole is evident at "A".

Plate 34. This stereopair illustrates the kettle-kame type of relief associated with some of the more granular moraines. Located in North Dakota, this relatively desolate area of sand and gravel hills forms one border of glacial Lake Souris, which is an area of flat poorly-drained soils. This moraine contains a multitude of hills of all sizes and shapes placed without orderly arrangement. The depressions (kettles) are filled with organic accumulations and are the only areas that are reasonably moist. The large boulders present in many of these hills can be seen as minute white specks on the hillsides (the fine white lines in cultivated fields are windrows of hay). The relief and porosity minimize any tendency toward surface-drainage development.

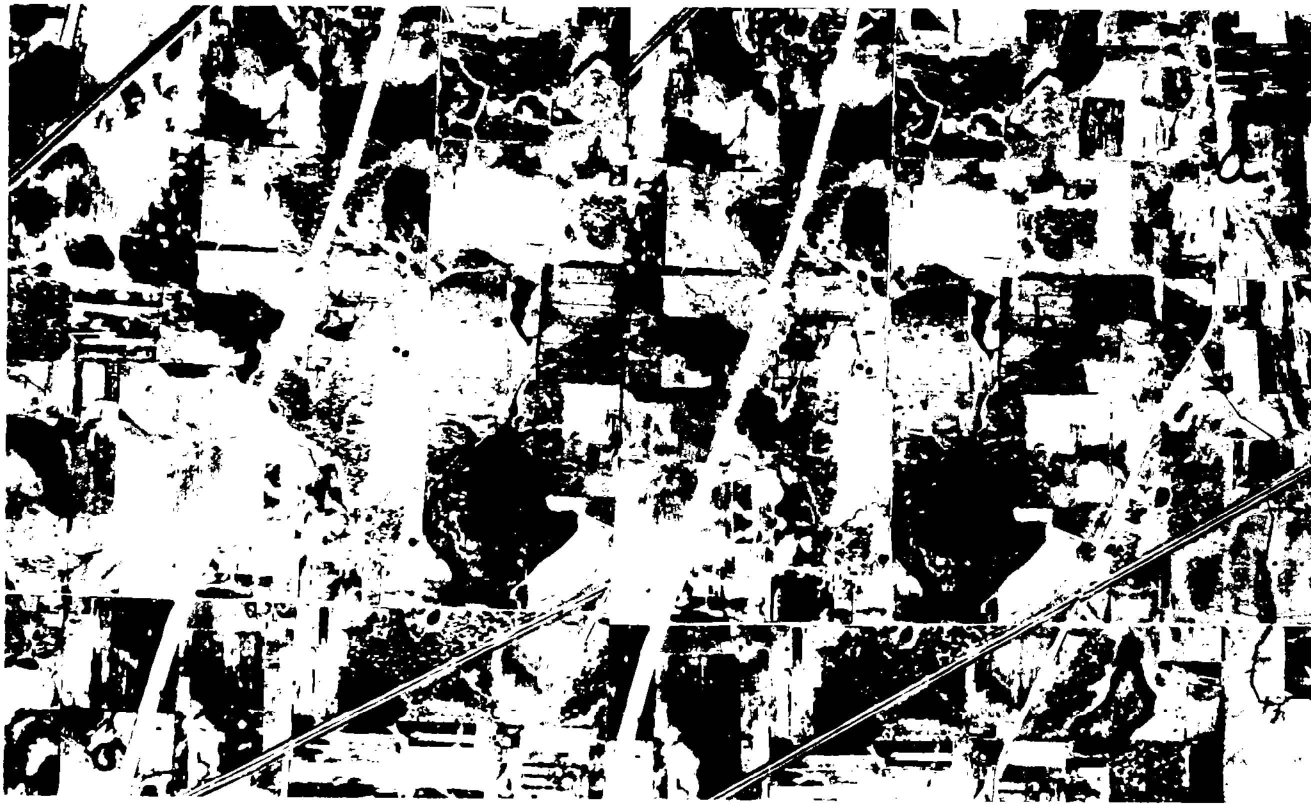


Plate 35a

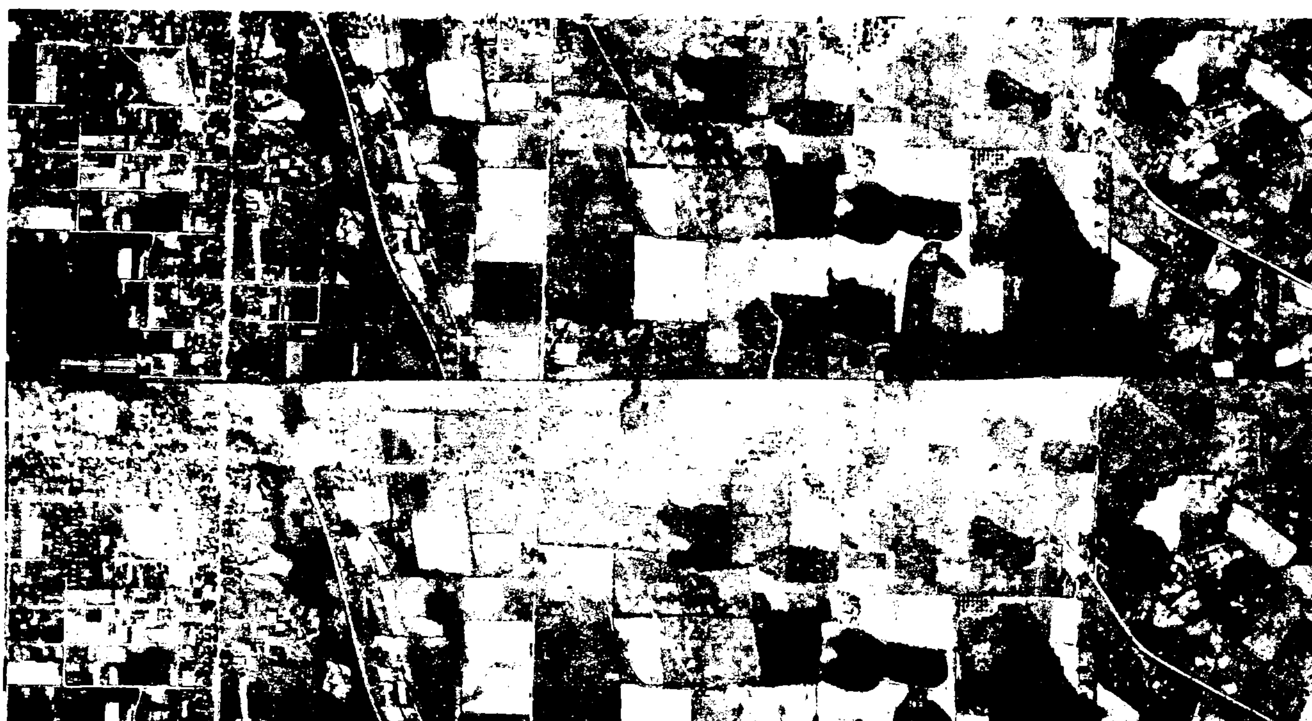


Plate 35b

Plate 35. (a) This stereopair illustrates a morainic area having a wide variation in soil texture and topography. Within the area shown, sand was found at "a", muck at "b". In most cuts the parent material is silt with sand and clay while under one embankment section "c" material having a liquid limit of 118, was sampled.

(b) An Ohio moraine of Wooster soil which was found also to have a parent material of silt with sand and clay. Included in this area are mucks, "b", in depressions, an esker lying parallel to the railroad, and the generally light soil colors associated with rolling typography.

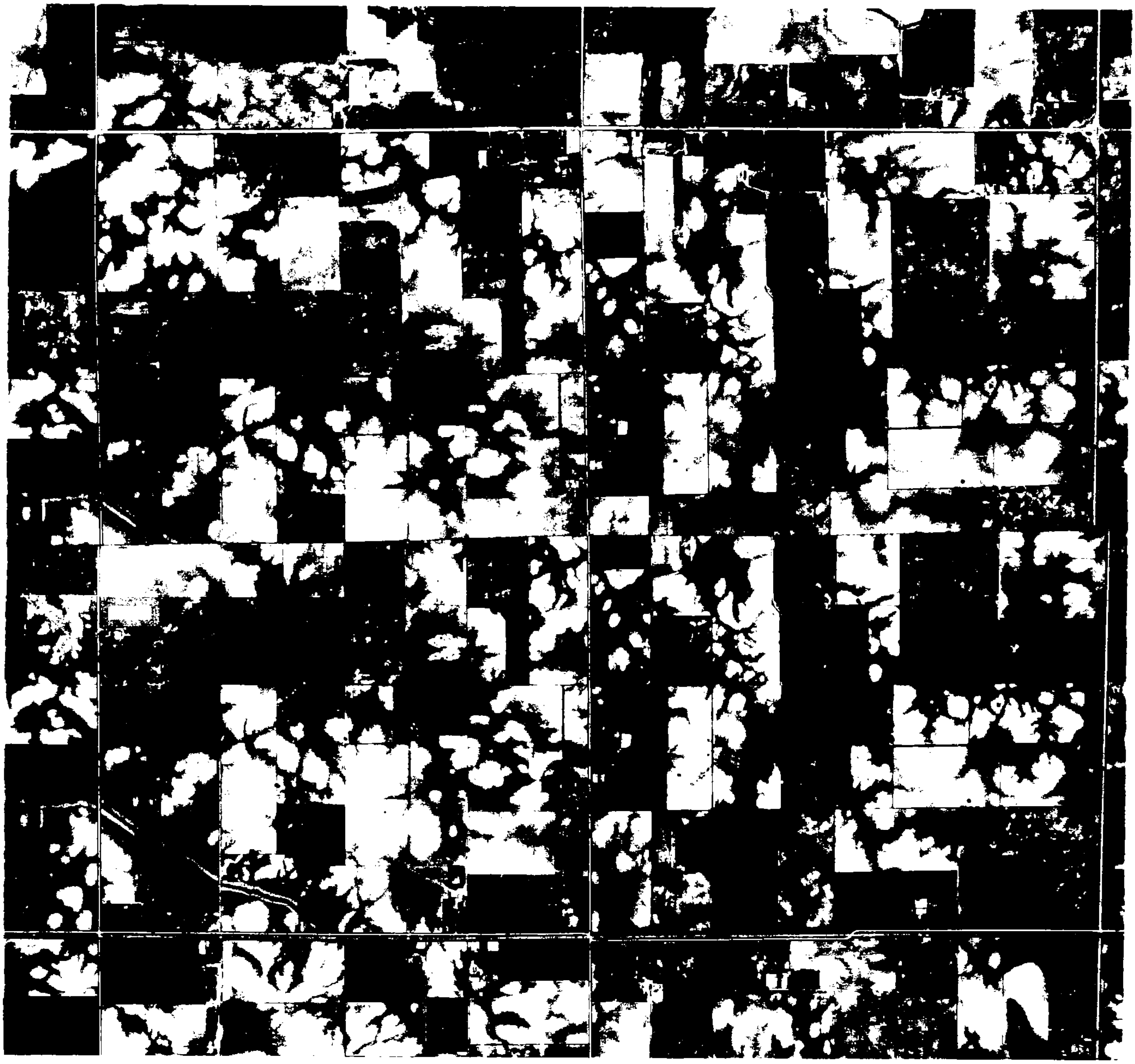
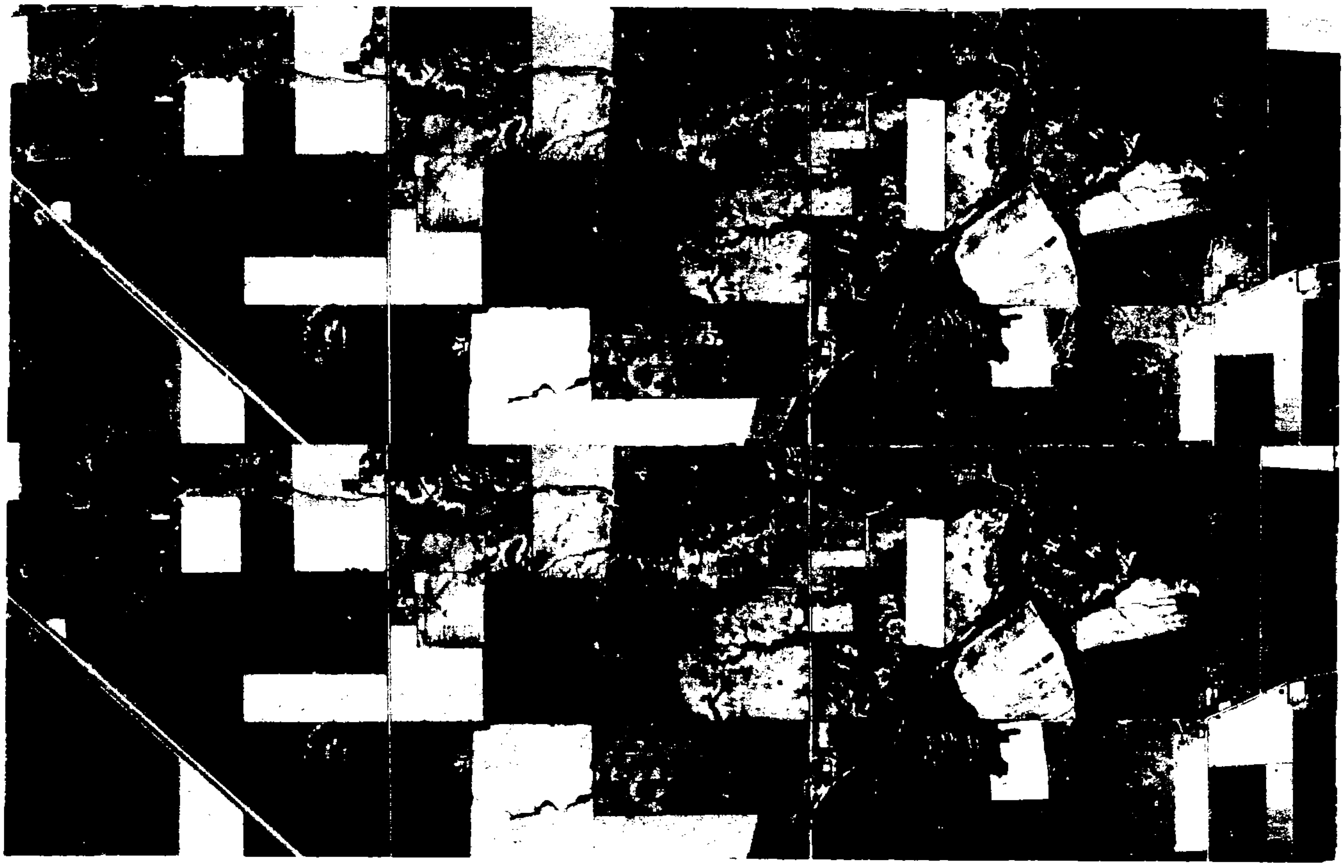


Plate 36. Glacial Till Plains. The most striking feature of this soil pattern is the interrelationship of the color and drainage elements. Developed on the gently undulating relief typical of till plains, this black and white pattern is an accurate map of the prevailing soil conditions. The dark, wet, plastic silty clays that occupy the depressions and the white relatively dry and more silty profiles on the slight rises are the two developed soils of the area. Local variations in relief are of the order of five feet or less. Because of the gentle slopes, proper alignment will require only shallow cuts. Slight fills on the dark soil areas minimize maintenance and increase service life especially on flexible type pavements. Considerable variation of subgrade soils will be encountered within short distances, especially when the depth of cut exceeds the depth of the weathered profile.

The computation of drainage areas, determination of locations for drainage structures, prediction of physical test results, texture, thickness and relative depth of horizons, optimum moisture content and the maximum dry weight of the compacted materials are some items of information that can be obtained from this interpretation, together with a knowledge of these properties on similar soils.



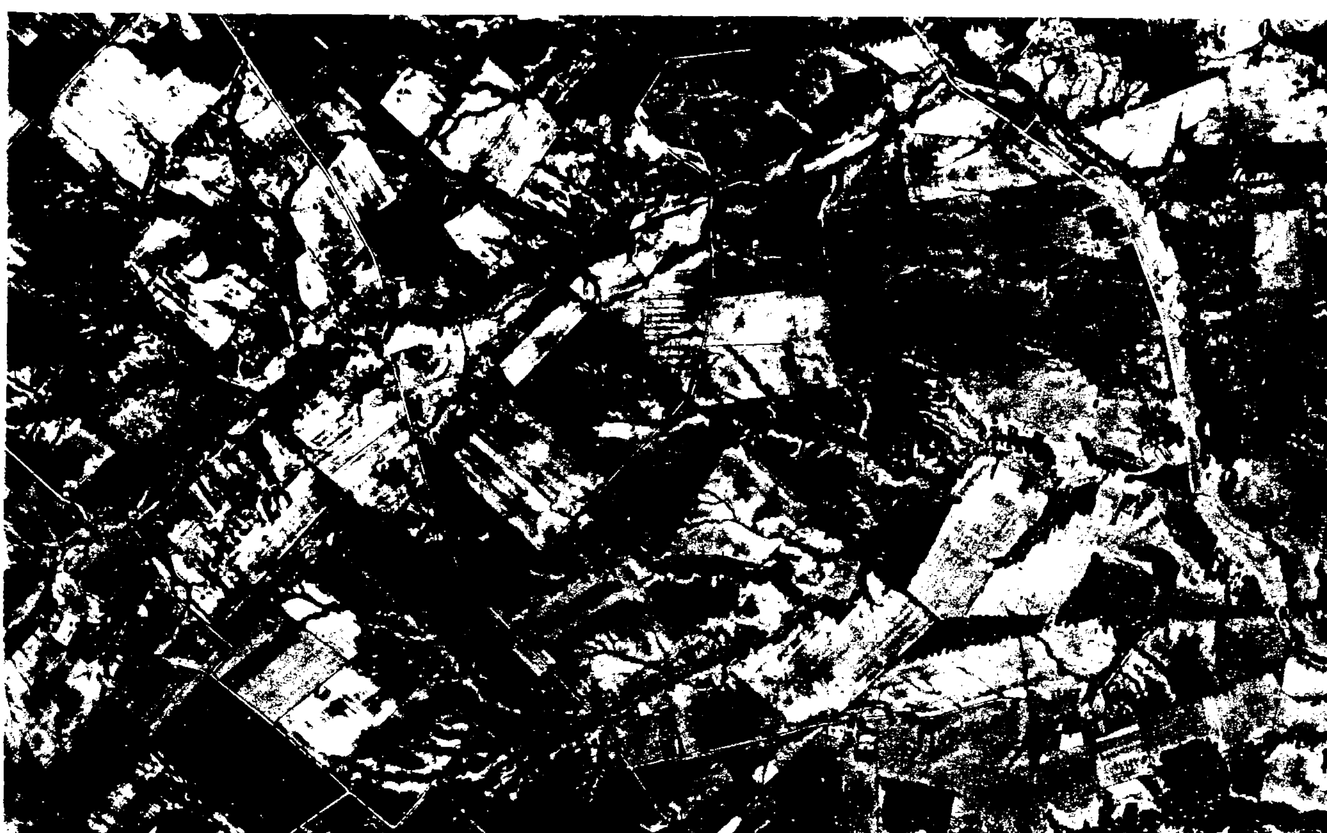


Plate 37

Plate 37. The two sections of this plate illustrate the soil pattern associated with the Illinoian (old) drift areas of the Central States. The single photo (Indiana) and the stereogram (Ohio) have in common the level relief that characterizes the inter-stream divides. Because of the imperviousness of the weathered profile the surface drainage pattern is highly developed. The white-fringed gullies are wide and shallow, a feature that is associated with profiles having contrasting textures in the horizons. The typical profile of this area, on the level upland, is repeated in each level area. The silty topsoil (white in plowed fields, and where eroded) averages 15 inches in depth. This silty material is underlain by weathered silty clay that forms an impervious barrier to percolation. The depth to unweathered parent material commonly exceeds eight feet. On the sloping ground, as on gullied slopes, the silty topsoil has been removed somewhat in relation to the ground slope. Here, the silty clay material of the B horizon occurs near the surface.

From an analysis of this pattern the following information may be deduced:

1. Extremely level inter-stream areas will require no cuts for flat grades; fills across shallow gullies; in cuts less than 10 feet deep the subgrade will be uniform silty clay.

2. As the completeness of the surface drainage pattern indicates that the permeability of the profile is low, subsurface drainage would be of questionable value.

3. Subgrade will have a very low bearing capacity with California Bearing Ratio approximately 2, which is typical of saturated silts and clayey silts. Three outstanding features of the soil profile derived from an examination of the gully pattern are the presence of (a) *silt* on a soil that is (b) *impervious* and in texture is a (c) *silty clay*. The silt texture is indicated by the white field colors and especially the white fringe around each gully. Its depth may be estimated from the vertical limits established on the upper and lower borders of the silt fringe. (b) The profile is obviously poorly drained, as determined by the amount and extent of surface-drainage development and the numerous "dead" furrows. (c) The dark color of the exposed "B" horizon in gullies, the uniform gradient of the gullies, the comparative resistance of the subsurface material to erosion, and the soft weathered slopes exposed where that horizon is exposed to erosion, all indicate that the texture is silty clay.

4. Field experience has shown that these soils require a raised grade line and adequate compaction in fills. Difficulty may be experienced in form alignment for concrete, the use of equipment in wet weather may be impossible, and maintenance costs on berms each spring and fall may be high.

Plate 38. The soil pattern shown on this plate is commonly associated with Kansan and other old drifts. Basically there is little difference between this and the Illinoian drift pattern; the chief difference being the absence of a white silt topsoil. The natural grass cover of this prairie soil contributes organic matter which darkens the otherwise white topsoil, such as is found in similar drift soils that were forest covered. The relief, amount of surface drainage, and character of slopes and gullies are associated with plastic silty clays. With a few minor exceptions the construction and maintenance problems are also similar to those in other old-drift areas.

Plate 39a

Plate 39b

Plate 39c

Plate 39d

Plate 39. This group of soil patterns shows the variation in till areas where undulating relief and relatively fine-textured soils prevail. Till plains in (a) Portage County, Ohio (Volusia soil). (b) Champaign County, Illinois; photo taken after rain accounts for fine lines in fields. This area is credited by some as having a thin mantle of loess. (c) Osceola County, Iowa (Iowan drift); (d) Blackhawk County, Iowa. In these western locations two factors inhibit the full development of contrasting colors found in the eastern drift. These are the organic content of the surface soils caused by the prairie grass development and the difference of about five inches in annual rainfall. Plate 36 shows the highest development of the color pattern.

Plate 40. In this stereopair an esker parallels the diagonal portion of the highway. This esker is unusually straight and is interrupted by a gap that permits the river to cross the line of the ridge. Close inspection shows the ridge form and several scars marking gravel pits, especially in the upper left. The pattern of impervious till similar to Plate 36 is seen in this general area. The broad black band stemming from the lower right and disappearing as it approaches the river is a low trough with shallow muck over clay, all underlain by sand at 2 to 3 feet. A kame can be seen between the trough and the relocated crossroad intersection.

Plate 41. A group of drumlins in Michigan. In each instance the outline, axial alignment, and form are those characteristic of this unique landform.

Plate 42. This outwash plain in a glaciated region illustrated the level land form that significantly includes numerous abandoned channels. The forested section covers a very slightly depressed trough that contains many faint channel scars. There a high ground-water condition exists that is not found on the sandy plain that is largely cultivated. Except for a muck-filled abandoned channel striking across the center of the sand plain, there is no evidence of surface drainage. This indicates a deep sand. Shallow sands on impervious material show faint markings of ground-water movement. A large area of muck occurs in the upper left

Plate 43. The flat expanses that are so impressive in lacustrine deposits are well represented by this area that was once the glacial Lake Chicago. The fine-textured sediments and the flat relief create both ponding and slow internal drainage. Dead furrows (fine parallel lines in fields) and excavated ditches provide some artificial drainage. The wide meanders of the channel also indicate poor natural surface drainage. Large areas of mottled black soil, often coincident with wood lots and swamp growth, are slight depressions where water stands on the surface. Field inspection showed that the principal highway, which is the white diagonal line, suffered from unstable soil conditions except where sand was used to construct a light fill.

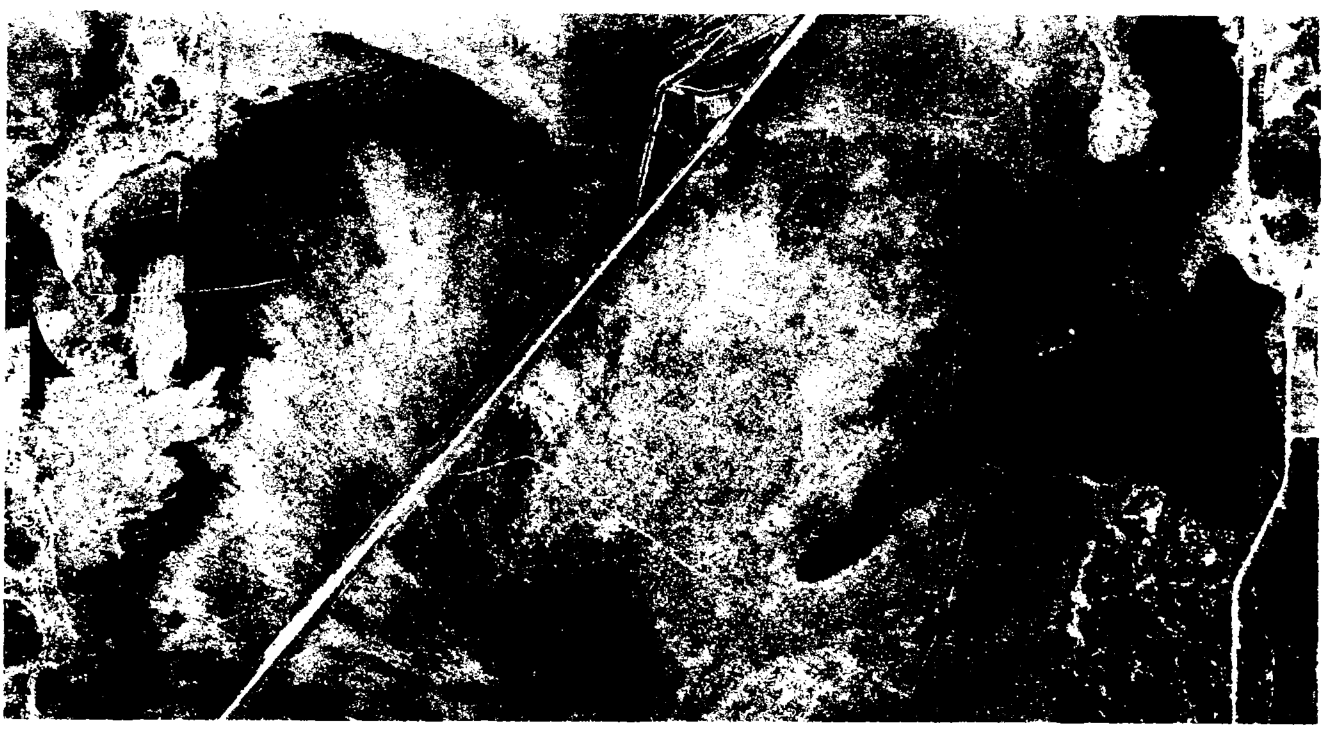


Plate 44. The striking contrast between a peat swamp and the surrounding area is well illustrated here by the relief, color, vegetation, and land form. Underground springs may account for the local body of open water. The white line running diagonally across this peat swamp is a railroad. A moss farm is shown, adjacent to the railroad.

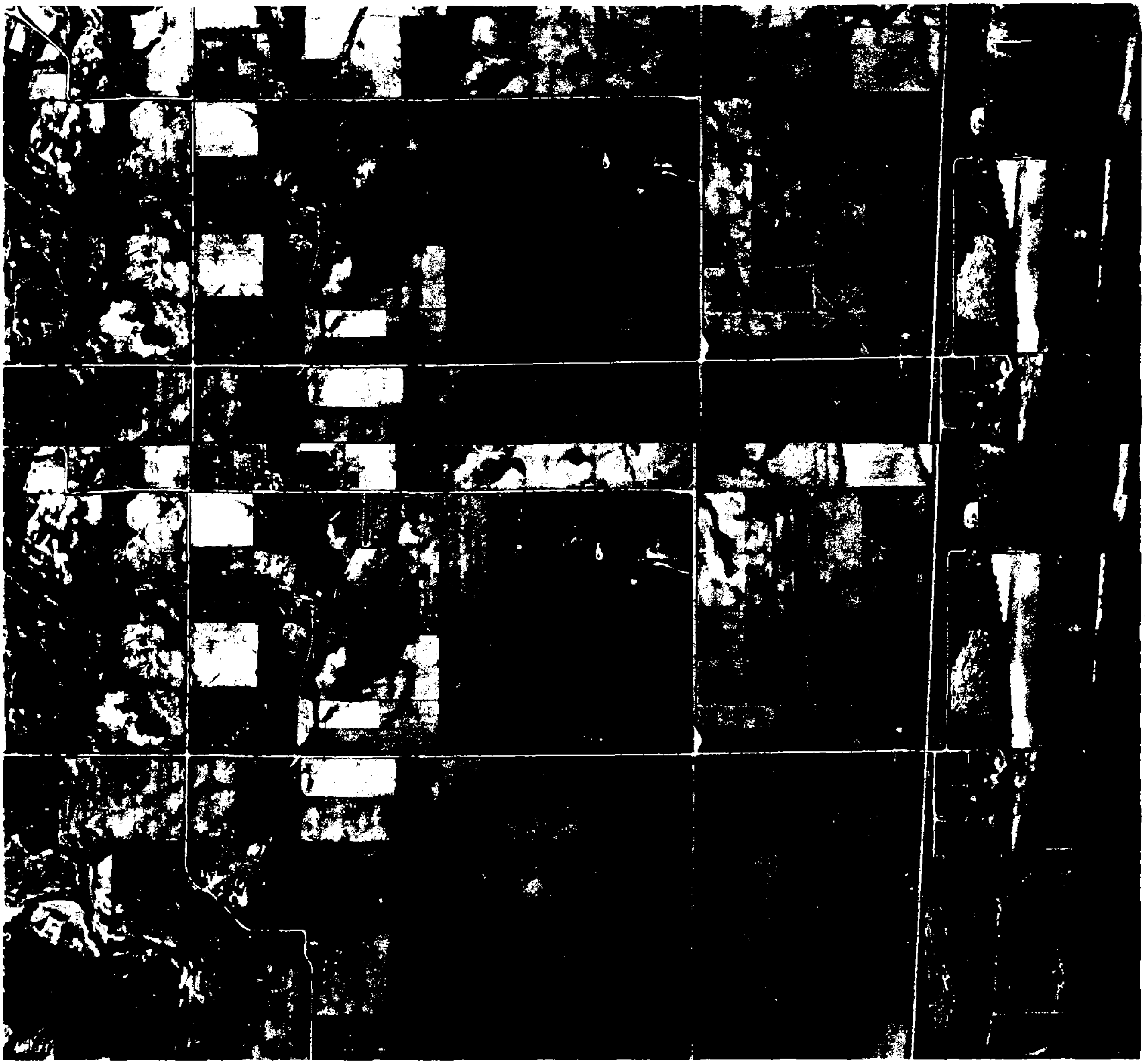


Plate 45. In this excellent example of a glacial river terrace shown as a stereopair all of the elements necessary to identification are present: The border between the glacial drift forming the valley wall and the gravel terrace can be identified since it is along this border that the streams, flowing from the relatively impervious upland, terminate. The granular terrace is sufficiently porous to absorb the rain falling on the terrace proper as well as that discharged from the uplands by the streams. Between the upland border and the recent alluvium stands the gravel and sand terrace, 60 to 80 feet above the river. Once the bed of a glacial river, it now dwarfs the narrow valley that accommodates the present river. On the terrace will be noticed that there is not continuous surface drainage but numerous evidences of short, shallow drainage ways leading to infiltration basins. Here the water collects to filter rapidly into the porous subsoil. The depth and degree of development of the weathered profile controls the number and extent of these basins. Where the profile is well developed as it is here the sandy clay B horizon extends to approximately 36 inches. Beneath this overburden lies the unweathered sand and gravel.

An important feature of prospecting for gravel is illustrated in the course of the stream flowing from the lower left toward the terrace. Rather than cut a channel across the gravel plain the stream follows the line of least resistance and maintains its channel in the more easily eroded material at the base of the valley wall.

Plate 46. Silty clay of the lower Atlantic Coastal Plain. This view contains most of the elements needed for airphoto analysis in this geographic location. The primary feature is the very flat, low terrain. The absence of relief indicates alluvial origin. The present stream possesses the two typical features associated with tidal streams. These are the short length and rapid decrease in width from mouth to source, and the stubby appearance of tributaries shaped as though opened by tidal pressure. The adjacent swamps and the intricate pattern of artificial drainage in all of the fields indicate a high ground water table.

These soils are predominantly silts and silty clays. The natural laws of deposition would confirm this since it is to be expected that those waterlaid materials occurring at the greatest distance from the fall line have, in general, the finest texture. The drab appearance reflects the poorly drained profile and relatively impervious texture. The close spacing between open drains is also an indication of the imperviousness of this material. Variations in the color tone reflect slight variations in drainage properties. The most poorly drained soils are darkest in color and contain organic material from swampy tributaries.

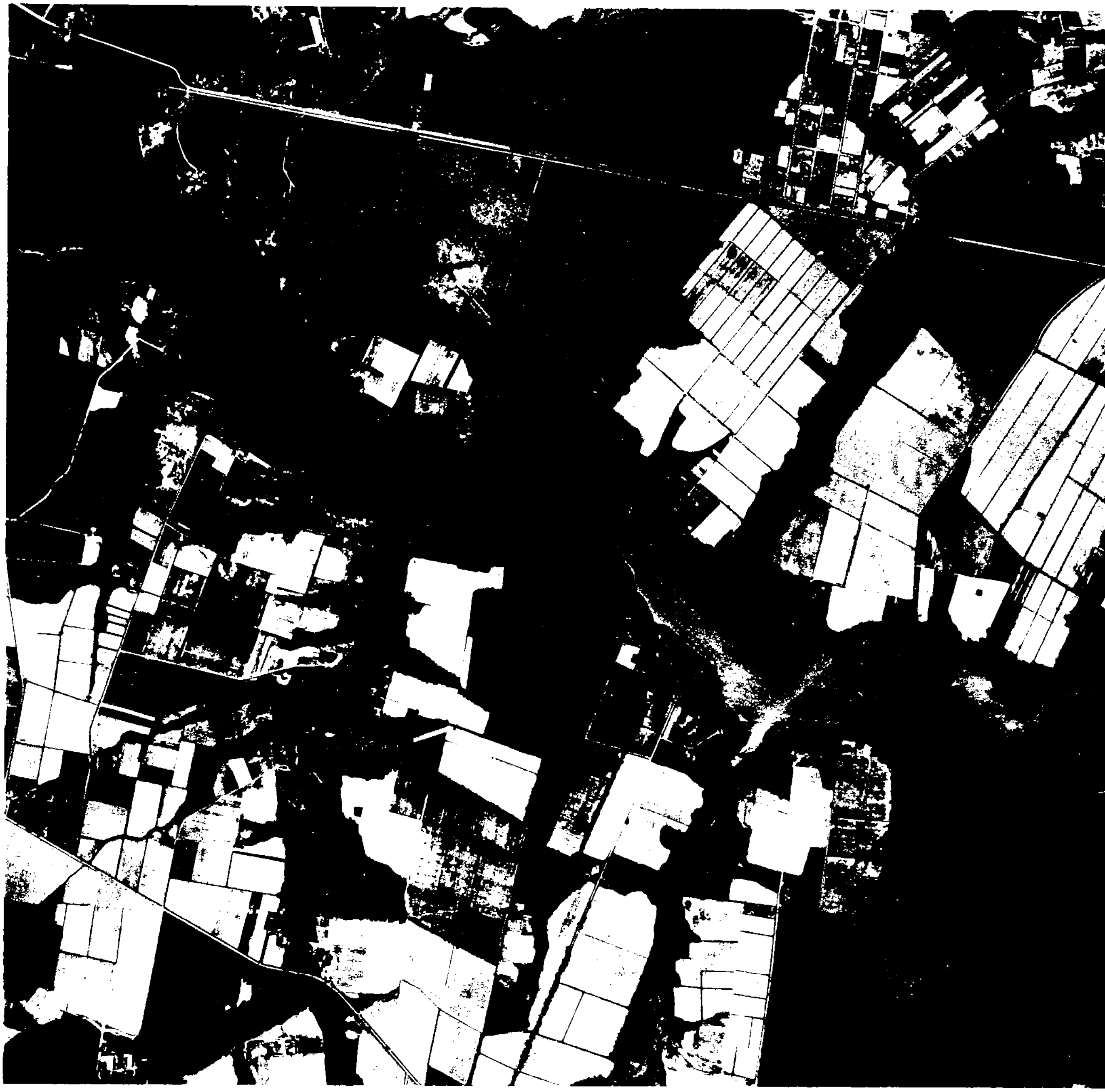


Plate 47. Silty to sandy lower Coastal Plains. The principal variation between this and the preceding illustration is the extremely light color tones in many of the cultivated fields. Otherwise the land-form pattern containing wide areas of flat terrain, and the drainage pattern indicating tidal influence and having associated swamps, are similar. The texture of the soils is more coarse and correspondingly less plastic than those in the preceding plate. Even within this area there is considerable variation in colors

Plate 48. Highly dissected upper Coastal Plain. Stereoscopic observation indicates the drainage-ways are not controlled by any form of bedrock as they are in Plates 9 and 15. In contrasting the color and erosion patterns with those of the accompanying illustration, it will be seen that the cultivated fields have an extremely light color indicative of sandy texture, and the several gullies are the type associated with friable materials. The land-use pattern as well as the vegetation are typical of the Coastal Plain. The terracing and contour plowing indicate that slope and texture promote runoff, causing sheet erosion if otherwise cultivated. In one of the very lightest areas, occupied by an orchard and indicated with an arrow, sampling showed the soil profile to consist of at least six feet of relatively loose sand. Some areas in adjacent fields show various degrees of color (red); there increased quantities of silt are found mixed with the sand.

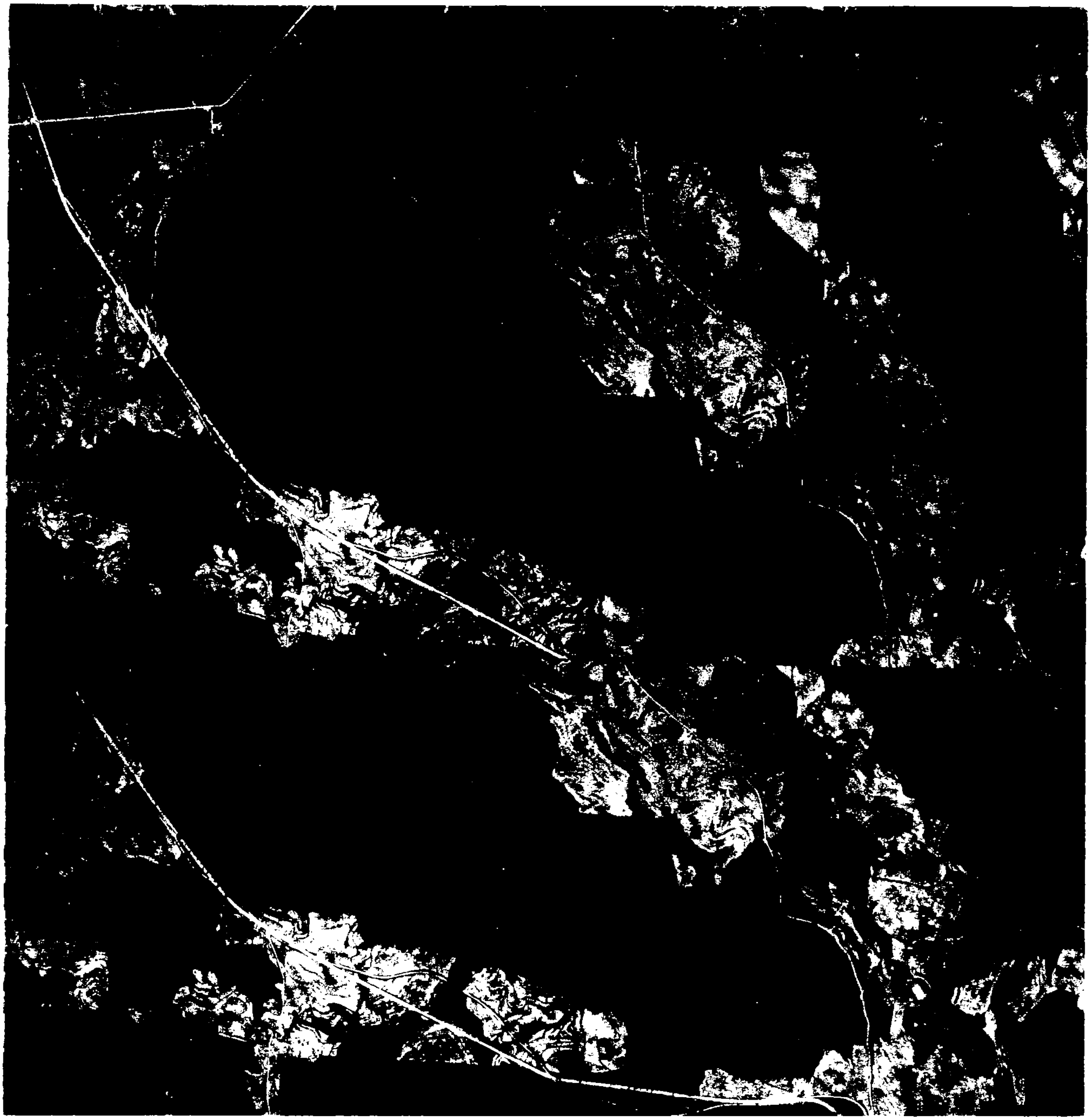


Plate 49. Sand-clays of the Upper Coastal Plain. The reddish color of the soils containing appreciable quantities of clay register dark in the black and white photography. Pedologically, these soils would be mapped as: Ruston on the dark-colored sloping ground, Pheba in dark upland depressions, with Cuthbert, a more sandy soil, appearing as the lightest in color in all topographic positions. It is interesting here to note the response of vegetation to moisture conditions. In those sections that are wooded, inspection will show a considerable variation in both the density and color of the foliage. The areas in which the soil climate is arid are sparsely covered with grasses and pine. (See also the excellent color patterns of other soils in Plates 21 and 36.)

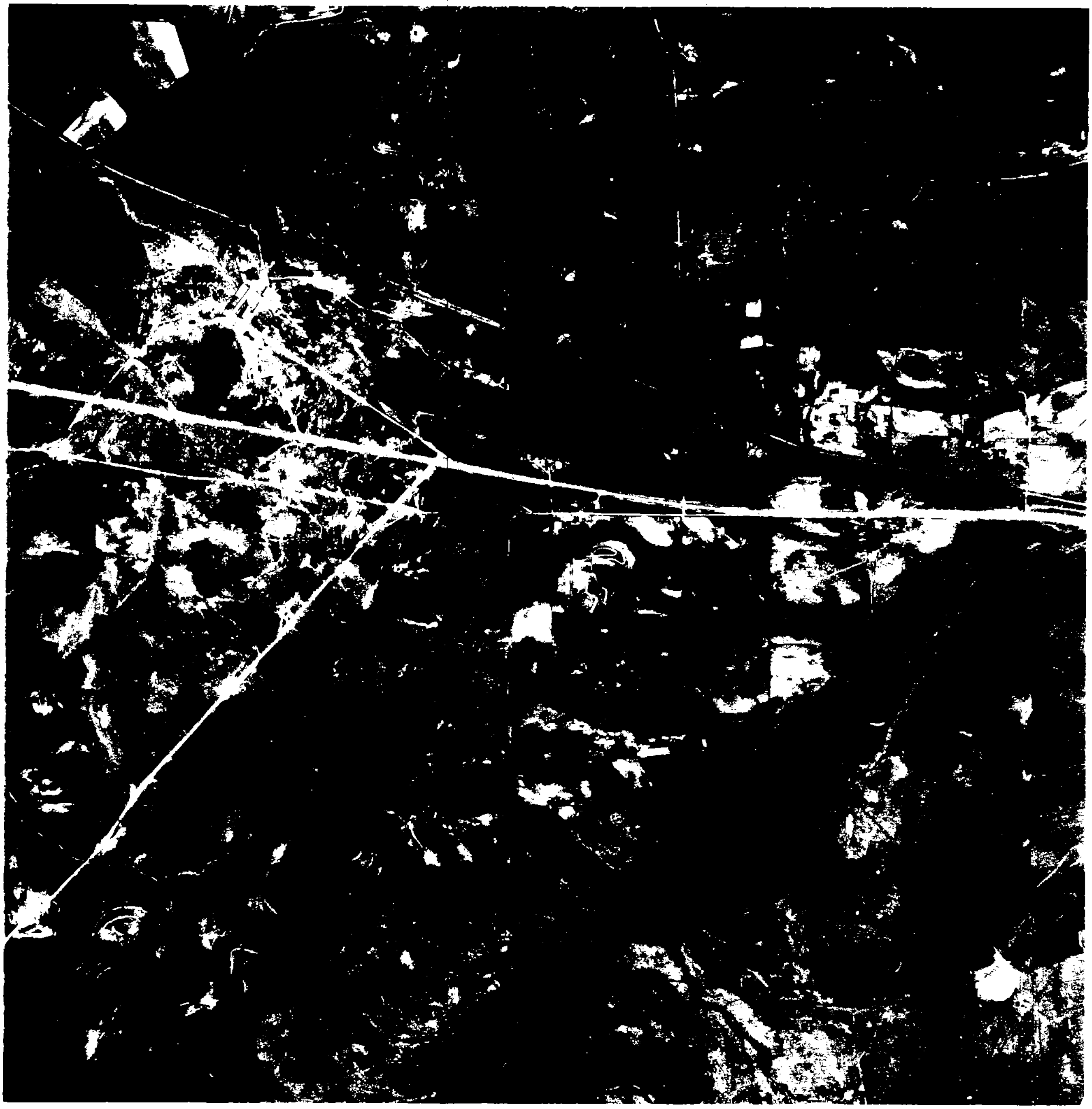


Plate 50. This photograph of the Black Belt in Alabama shows the wide color variation in an area which from the ground appears black (Fig. 84). Field exploration shows that the texture and depth of profile varies with the changes in color. The blackest area in the depressions have a high clay content while the moderately light tones indicate the relatively shallow profile containing a large proportion of silt or calcium carbonate. The small areas of extremely light color are where the underlying chalk is exposed, generally on tops of hills and ridges. The erosion-control terraces give evidence that the soil is highly erosive.

Plate 51. This stereopair shows one of several soil patterns found in that formation of the Great Plains Outwash Mantle mapped geologically as Ogallala. The most outstanding feature is the presence of large circular depressions which contain water for days or weeks following wet weather. Depression "A" has dried to some extent.

The striped appearance is the result of contour plowing and terracing to control sheet erosion. A stereoscopic examination shows that the relief is gently undulating, so that the occurrence of sheet erosion indicates that the subsoil may be impervious. The soil conditions in these areas are exceptionally uniform in comparable positions. The clay content and depth of the soil profile increases toward the center of the depression. On the higher inter-depression areas the soil profile contains relatively large proportions of silt and fine sand. Consequently, soil surveys made with aerial photographs in this area are accurate as to depth, texture, plasticity, and water conditions.

The depressions shown in this photograph are probably more numerous than would be considered as average. Where cultivation, especially that on the contour, is not practiced the depressions are less noticeable in an airphoto.

Plate 52. The important feature of this vertical photograph of a partially denuded High Plains area is the obvious pattern of water-laid materials. This influence of channel markings and current scars indicates immediately that the soils of the area are derived from old alluvial deposits. In general, as the distance from the mountains increases, these channel patterns become less pronounced and occur at greater intervals. Judging from the extent and activity of the channel influence in this illustration, it can be assumed that this is near the source of outwash. The airport shown in the pictures lies immediately in the channel of this ancient stream. Water-laid materials of different ages can be distinguished. The airport, while not on recent alluvium, is on water-laid materials that are younger than those in the upper right that were deposited by water flowing at right angles to that depositing the younger materials. It is interesting to note that the runways are in various stages of construction, one runway having windrows of asphaltic material placed in preparation for spreading and compaction.

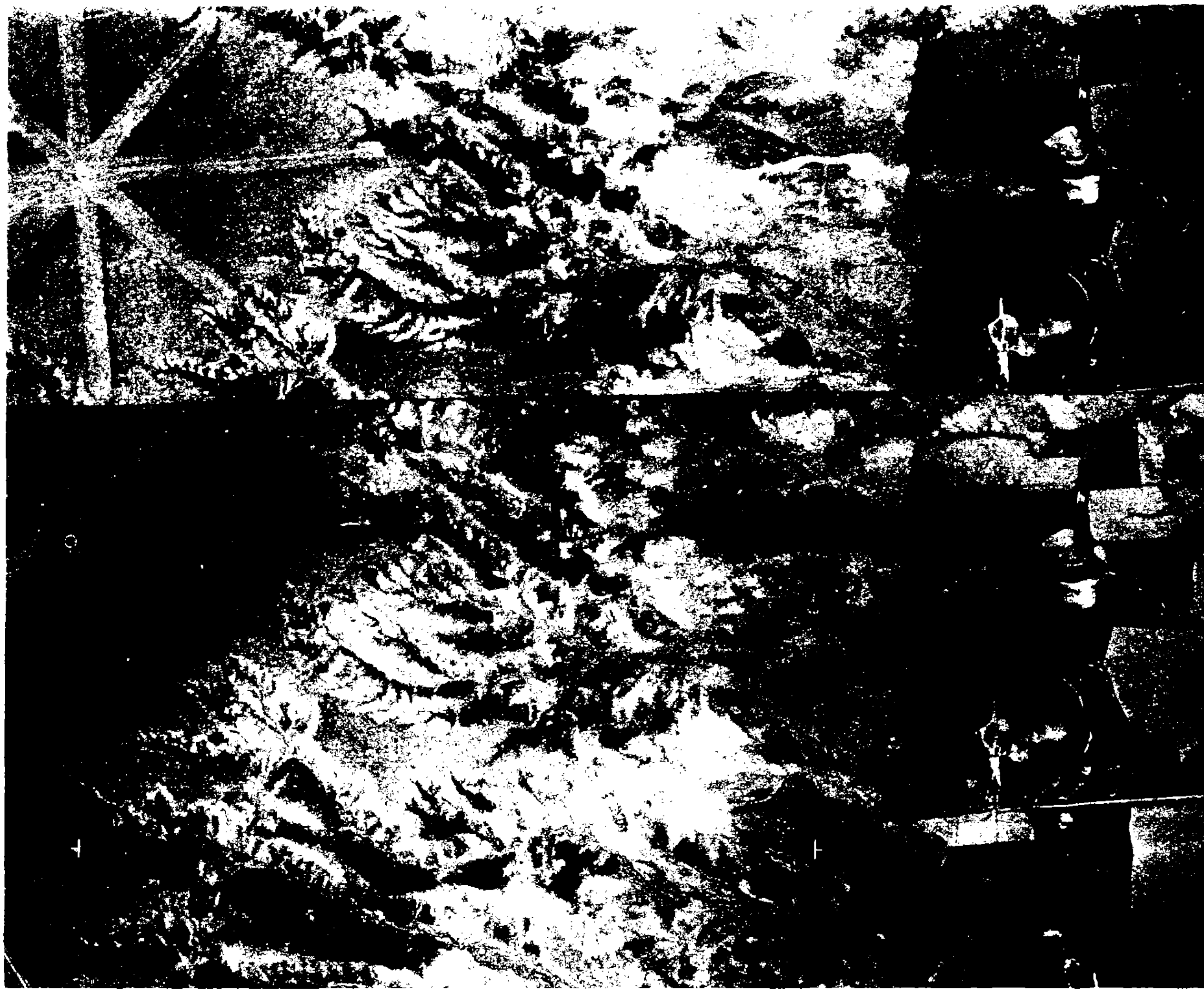


Plate 53. This stereopair shows the transition zone between the recent alluvial areas adjacent to present streams and the upland Rocky Mountain Outwash—or Tertiary—mantle. The irrigated and cultivated alluvial terrace is in striking contrast to the dissection that is gradually removing the deep non-irrigated and arid mantle. The very plain, unbroken surface of the upland indicates that the material there is relatively coarse, and the lack of contrast in colors indicates uniformity of soil conditions. The steep gradient of the transition zone encourages erosion.

An examination of the gullies and the eroded area in general shows, first—the presence of a weakly developed caliche horizon, evidenced chiefly by the white fringe at and near the erosion face. At lower elevations, the materials now exposed by erosion have slopes that can be seen to be rather gentle and individual knolls are well rounded. These conditions imply that the surface material is underlain by beds of silty clay. A careful study of portions of this area shows a scattering of very small circular dots. These are gopher mounds which usually indicate a relatively well-drained soil.

Plate 54. This illustration shows only one of the unrelated land forms exposed by removal of the Tertiary mantle. The area on the left is a more or less level upland that once extended entirely across the area covered by the picture. At the present time headward erosion is progressing toward the upper left corner and is carrying the sediments away in a small valley developed in the lower center. This process of removal has exposed the sharp ridge crossing the center of the photograph. In all probability, this rock ridge was formed long before the temporary burial by the outwash sediments. Subsequent erosion and removal of the sediments may expose a much more complete pattern of this ridge. Gradual lowering of the surrounding plain will also heighten the relief now existing between the lowest part of the picture and the top of the ridge.

Plate 55. (a) This stereopair shows the zone of destruction and transportation in a filled valley area. The bare rock mountains and remnants are severely eroded while the vast sweep of debris is being transported downhill toward the center of the valley. The black spots that seem to form definate paths are desert shrubs that are growing in the shallow channels where subsurface water conditions are more favorable to growth. Here the texture of the material is predominantly coarse and little segregation has taken place.

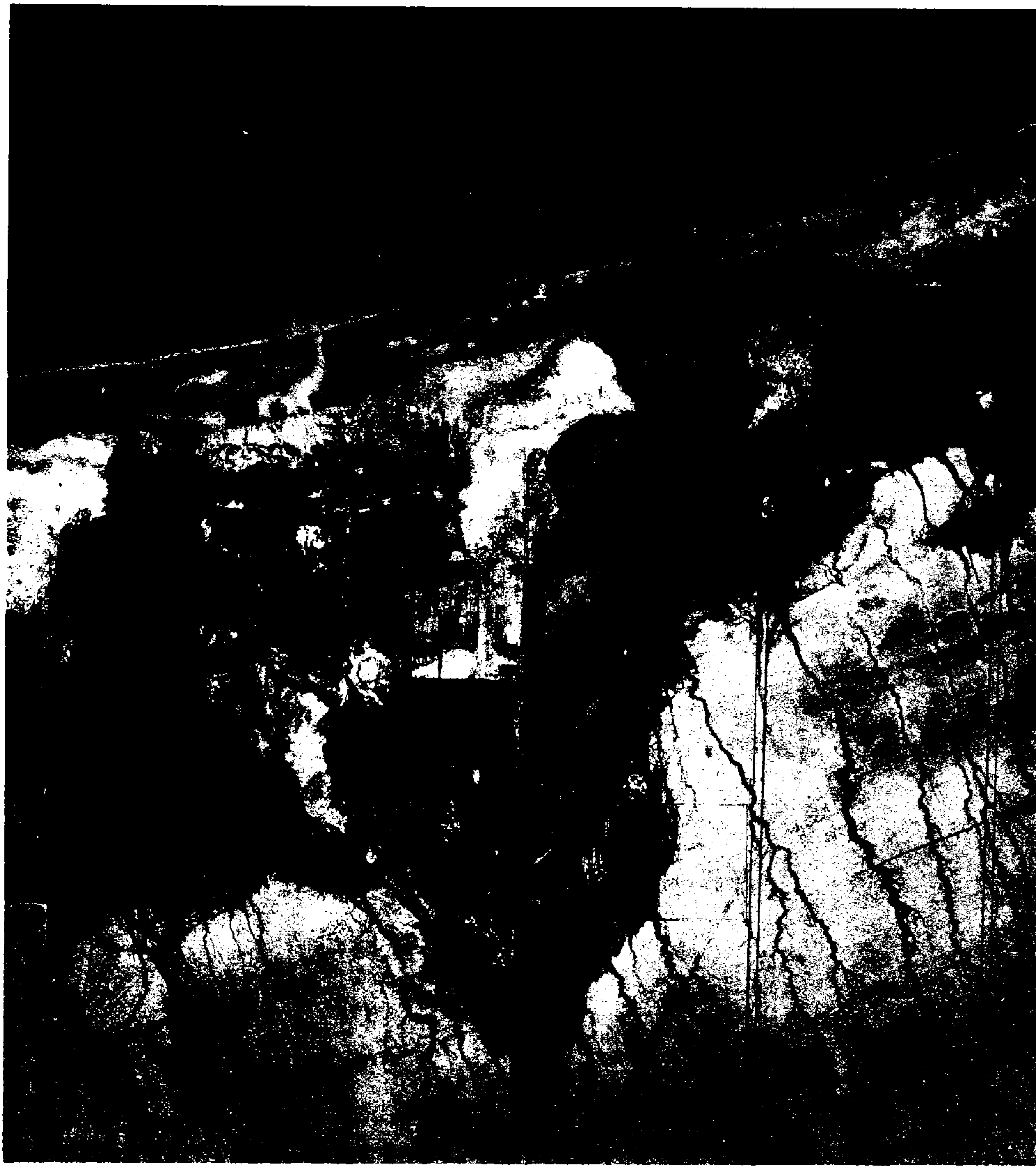


Plate 55. (b) in the center of the filled valley there may be a stream or a temporary lake as shown in this view. This is a zone of segregation and deposition. As the gradient of the stream drops the channels fan out and deposition occurs in the swampy area; in the lake proper, the clays settle out to form the flat lacustrine areas common in filled valleys. A fringe around the lake that is alternately dry and submerged is particularly complex in profile.

Plate 56. This is clearly a soil pattern of a broad area of recent alluvium. This Mississippi alluvium possesses the identifying features of level terrain and channel scars that characterize the land form of alluvial deposits. The soils shown in this area are plastic (liquid limit of 70), poorly drained silty clays that are pedologically identified as Sharkey. The dark color, an intricate system of open ditches, which are the broad diagonal lines, and the practice of alternating spoil banks of ditches all emphasize the impervious nature of this water-laid material. The numerous small white patches are surface smears of sand blown from the adjacent natural levee.

Plate 57. In the selection of sites in alluvial soil areas such as this a wide variation in subgrade conditions may be avoided by selecting well drained terraces for the general location as well as by shifting and adjusting the alignment of runways. The light-colored areas are coarse sand and fine gravel while the dark areas (channels) are wet silty clays. The mottled color pattern (M) on the major terrace indicates local occurrences of silty clay soil as the terrace tapers toward an impervious soil area. Orchards, (o), often an indication of well drained materials, are seen to be located on the light colored areas.

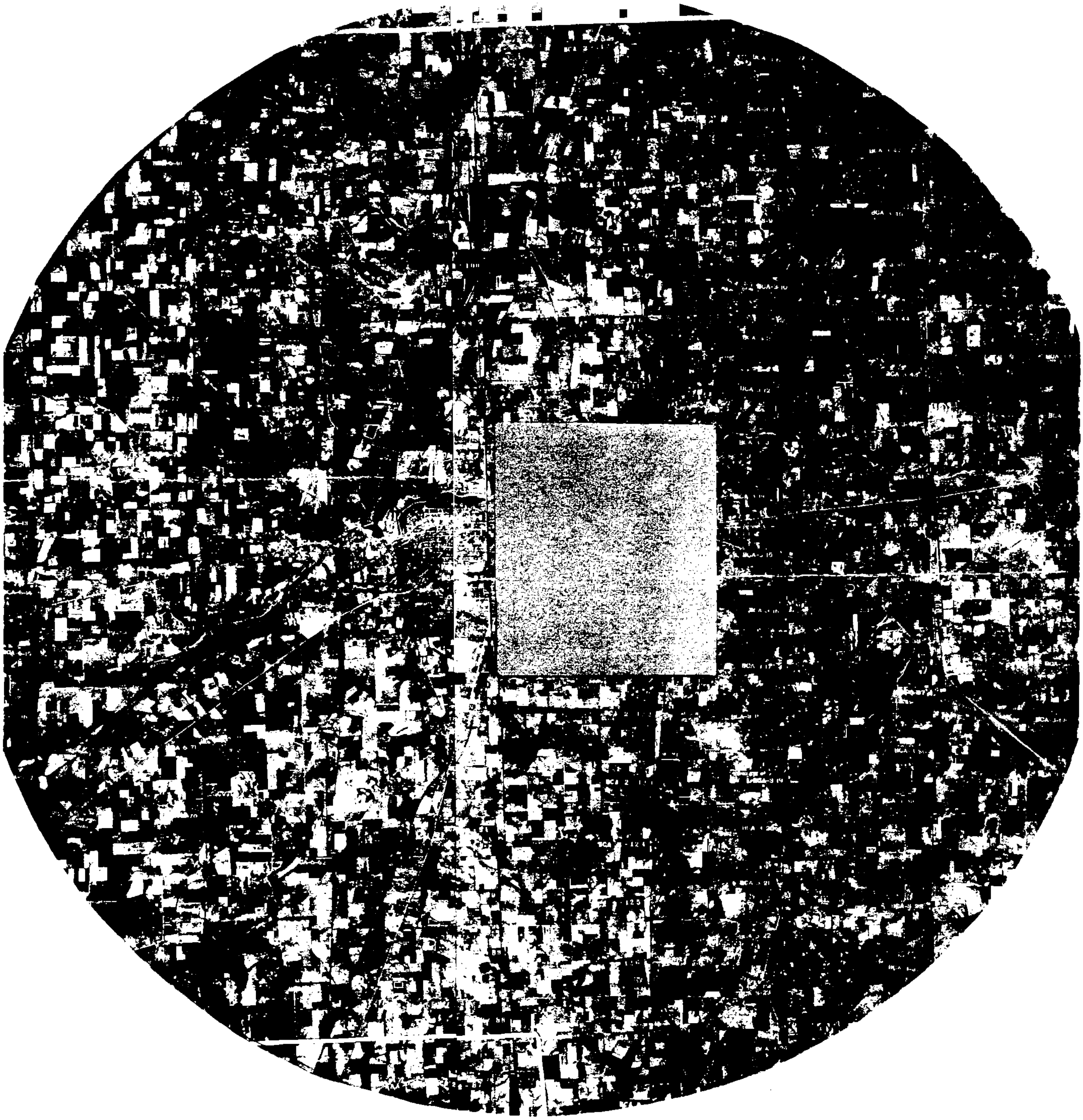


Plate 58. Aerial photographic index of county showing the present stream valley to the north and southwest of the city; rolling morainic area north and west of the stream valley, limestone sinkhole area east of the stream and north of the city; low soil covered terraces and rock terraces to the east and southeast of the city; glacial till plains due south of the city; and elevated granular terraces northeast and southwest. Map, Fig. 85, which covers an area having a radius of approximately eight miles with its center at the heart of the city, shows the soils of the area considered for a new airport. That map was prepared entirely from airphotos.

Fig. 59. This stereoscopic pair of airphotos shows the location of the present airport which is situated on low, soil-covered-granular terrace soils of the TG-2 class. The left half of the picture is a drift-alluvium-covered rock terrace on the TR class. As there is little likelihood of flooding by nearby streams the present site is favorable for a small airport. Relocation of highways would be required for longer runways, and the rock terrace might offer an approach obstruction.

Fig. 60. This stereoscopic pair clearly shows the elevated granular stream terrace of the TG-1 class two miles northeast of the city. As the soils of this terrace are sands and gravels, no subbase would be required.

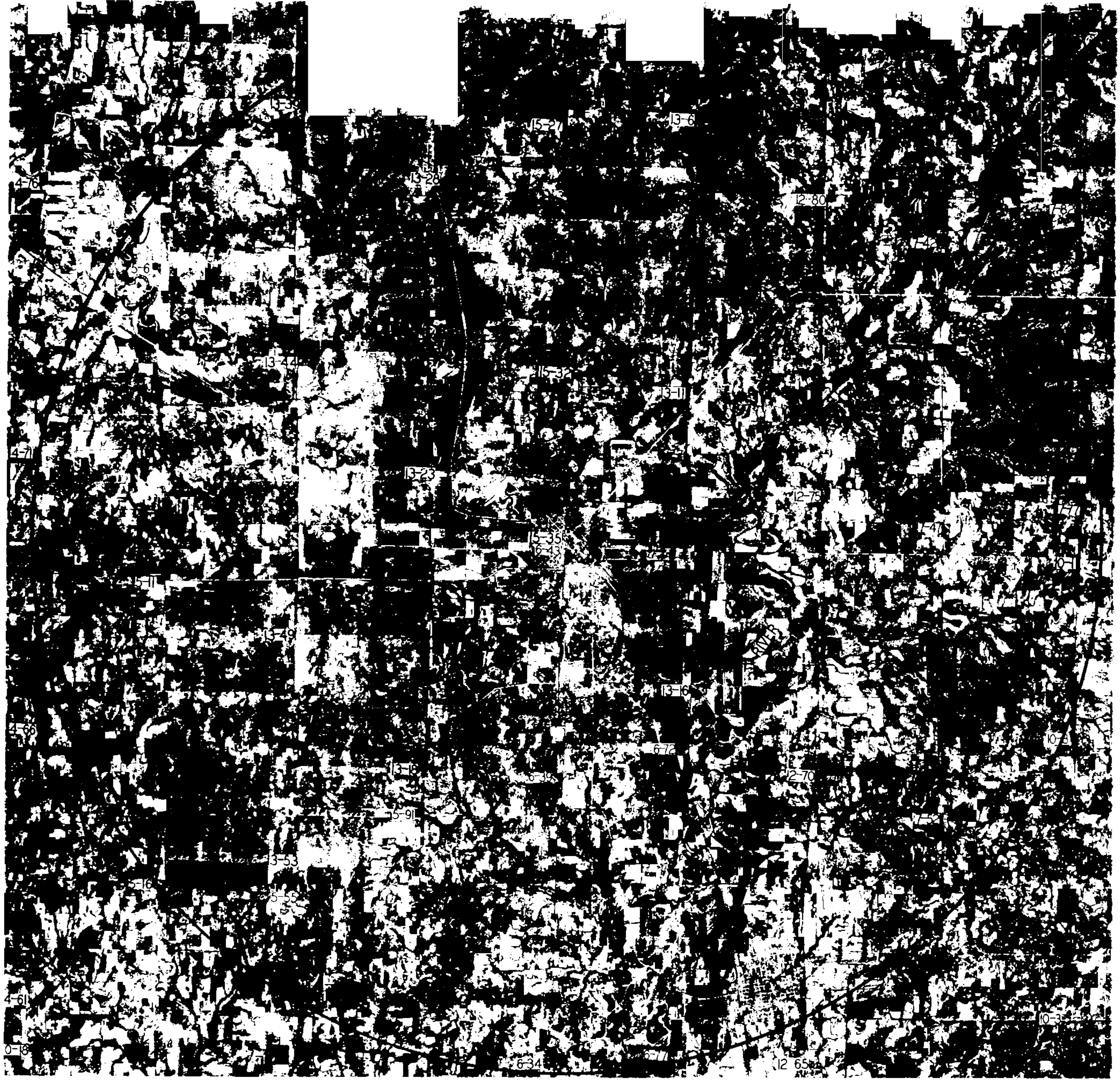


Fig. 61. Aerial photographic county index sheet of part of the county in the Redbed Shales and Sandstones, showing the circular area of 8-miles radius to be considered for an airport site. (See also map, Fig. 87.)

Plate 62. (a) Existing airport and vicinity illustrating the two types of erosion observed in the sandy clay and plastic clay soils. As the two dark V-shaped gullies progress through the sandy clays their shape changes to broad flat sections in the underlying clay soil farther down the slope. (See Figs. 70 and 71.)

Plate 62. (b) Stereoscopic pair of airphotos showing soils of the Upland Residual Redbed Shales and Sandstones "R", High Terrace "T", and River Alluvium "A". The abandoned meanders indicative of old streams can be seen. The few very small white spots are gopher holes, indicative of well drained soils.

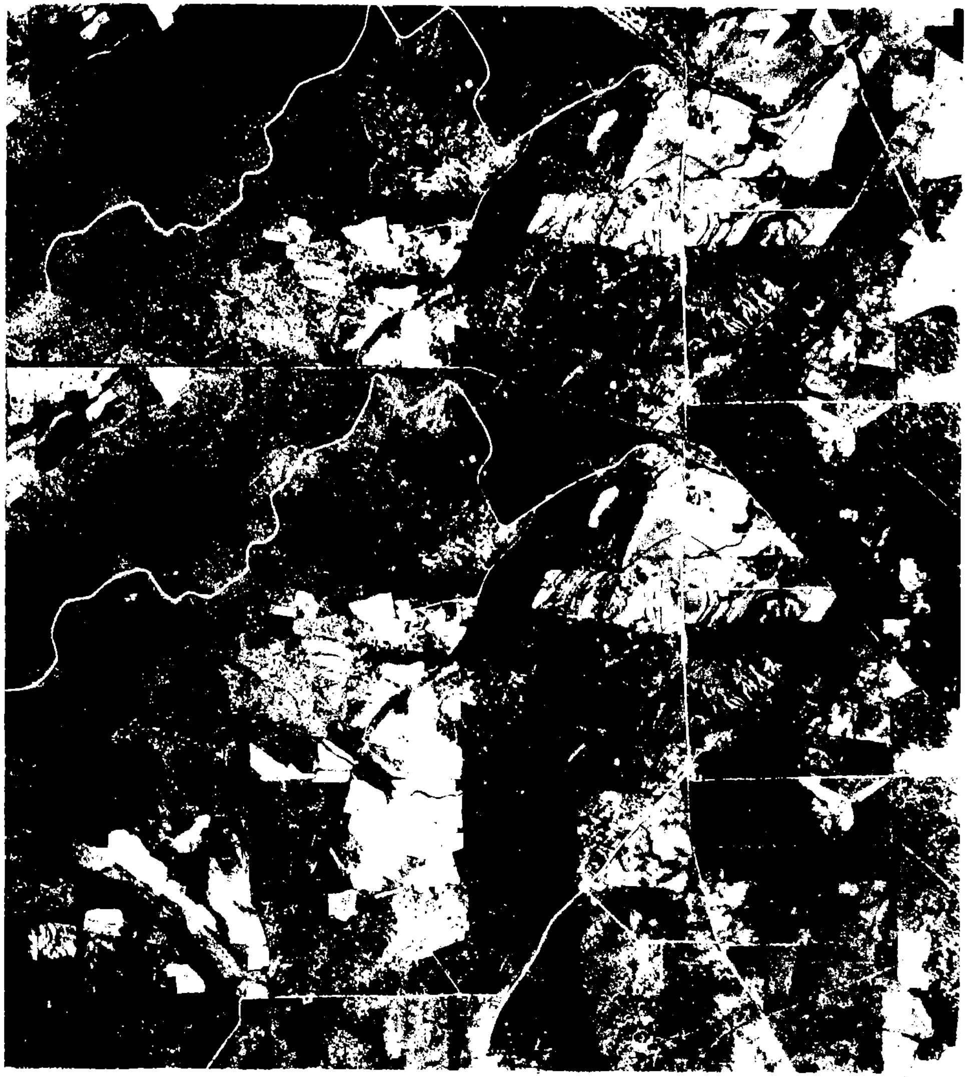


Plate 63. (a) Stereoscopic view showing the folded character of the interbedded sandstones, limestones and shales. In the northern part, with a highway on its crest, is a high uplifted mountain which might provide a water intake area for springs in the airport site in the southeastern corner of the pair. The fine hairlike lines in the airport sites are survey lines for runways which were staked shortly before the photo was made.

Plate 63. (b) Stereoscopic view of the new airport site showing mar folded limestone and shale outcroppings where wet weather springs risir in the airport may receive their supply. A few partly developed sink-hole can be seen to the west of the highway.