PHYSICAL GEOGRAPHICAL PICTURE OF CSONGRÁD COUNTY

L. JAKUCS

With its area of 4262 km^2, Csongrád County occupies only 4.6% of the total area of Hungary, that is it is among the smallest counties. Its surface is virtually flat, and it holds no tourist attractions in the form of hills or tumbling waterfalls. The picture of Csongrád County is one of a characteristic plain surface; in most places it appears almost as flat as a billiard table, the most prominently outstanding features being provided by cairns a mere few metres high, or the gentle slopes of the flat-backed drift-sand dunes built long ago by the wind to the west of the River Tisza valley.

This is the area on which the deepest plain of the entire country developed. In the region where the River Tisza and the River Maros combine, the terrain is only 78–79 m above the level of the Adriatic Sea. It is not surprising, therefore, if the running waters of the Hungarian Plain strive from all directions into this deep-lying region. There was a time when even the River Danube meandered over the area that is now Csongrád County, finally freeing itself from the arc of the chain of the Carpathians.

Naturally, the areas on the edges of the county are somewhat higher than the central Tisza Valley. Thus, on the south-eastern side the height above sea-level rises to 95 m, and on the south-western border of the county to 125 m. However, because of the large distances involved, this difference in level of at most 40–45 m is not sufficient to be sensed with the naked eye. On the low-lying flood plains, the average fall in the level is only 10–40 cm per km, and even on the most plateau-like drift-sand – loess table-land between the River Danube and the River Tisza it is merely 1–2 m per km *(Fig. 1)*. Such a slight slope in the terrain is therefore best indicated by the bed directions of the running-waters. Water will always certainly find the deepest troughs in the surface of the Earth.

The running-water axis in the county is formed by the River Tisza; this is joined at Csongrád by the Triple-Körös, and at Szeged by the River Maros. Apart from these rivers, there are virtually no other appreciable water-courses in the county, though not too long ago the River Kurca also existed. Branching out from the Triple–Körös shortly before that river flowed into the Tisza, the Kurca followed an ancient river valley and meandered in the one-time bed of the Ér–Berettyó–Körös. Its role was to lead off a good proportion of the flood-water of the Triple-Körös at times when the Tisza (because of its own high water level) was not able to accept this at Csongrád, the site of the natural junction with the Triple-Körös. When the embankments were

Contour map of Csongrád county

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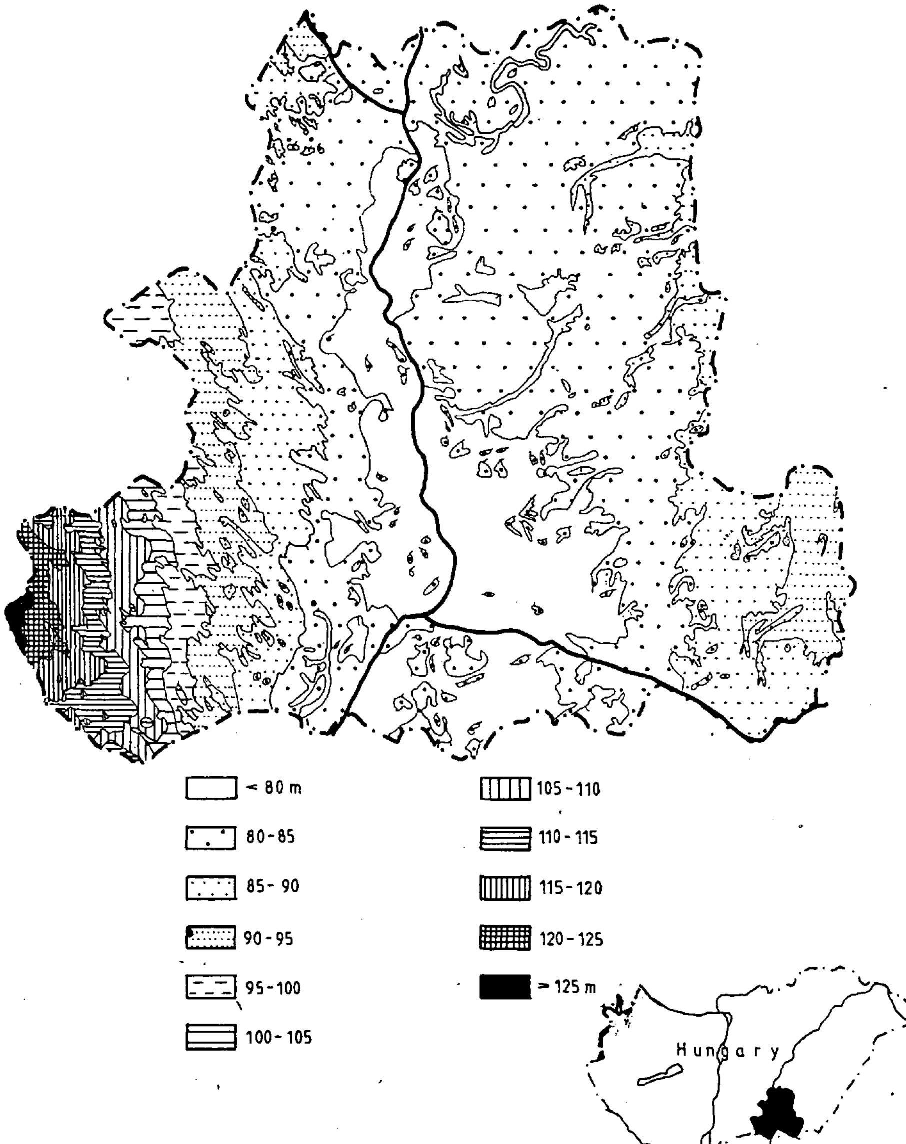

Drainage density of Csongrád county

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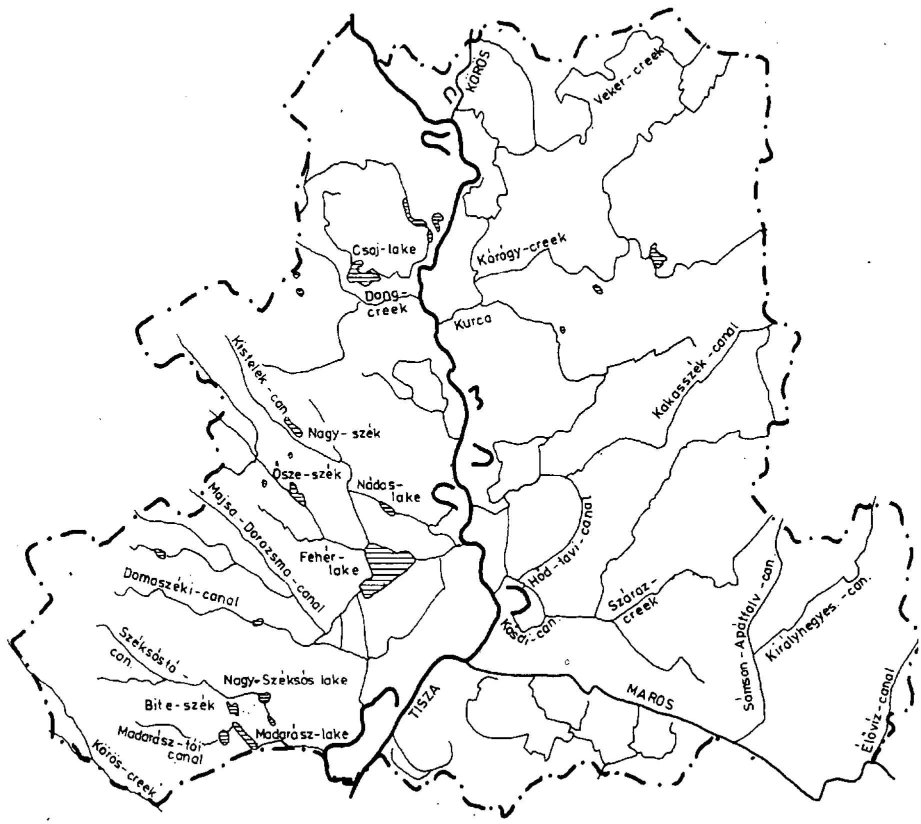

constructed along the Körös rivers, however, the Kurca was suddenly deprived of its running-water replacement, and its bed has subsequently become a 37 km long meandering inland canal *(Fig. 2)*.

Within the county it is possible to find a fairly large number of other such inland canals, or water-beds carrying water for irrigation purposes; these have been deepened out, at least in part, into the axes of one-time marshy tracts and periodic streams. The soil-waters fed from the large quantity of precipitation infiltrating in from the surface of the old talus of the tributaries in wet years all flow in the direction of the Tisza Valley. However, on the rim of the Tisza Valley flood area, which consists of a water-retaining clayey-silty sediment, these soil-water flows are stopped and the water is forced to the surface. This was the reason for the notorious "wild-water" catastrophes in the area of Szeged and Hódmezővásárhely, which caused particularly extensive damage in the unusually wet years 1940–42. (A large proportion of the periodic water beds were converted to canals at that time.) At present, the area of the county is protected from damage by inland waters and wild waters by a total of about 1500 km of canals and nearly 40 pumping stations.

In the period before the regulation of the rivers and the construction of the embankment systems, the greater part of Csongrád County was naturally inundated on the occasions of the great floods of the Tisza, the Körös rivers and the Maros. Independently of the floods, however, the left bank of the Tisza above the junction with the Maros was an area almost constantly covered by water up to the time of the regulation The district of Hódmezővásárhely, for instance, was freed from the constant danger of damage by inland waters only following the construction of a dense waterway network *(Fig. 3)*.

The flooding of the Tisza generally begins in March and April, following the spring melting of the snow on the hilly catchment areas, but it may also extend to May and June. The early spring flooding is usually the more dangerous, for at this time the flood–waves of the Tisza, Körös and Maros may coincide. Experience shows that when the flood-waves coincide in April and May, long-lasting and dangerous floods may result. This was the case with the flood in 1879, which destroyed the city of Szeged, and also with those in 1919 and 1932, which set new record water levels.

It is interesting that summer flooding of the rivers has recently become increasingly more frequent. At the beginning of summer in 1970, the Tisza, the Körös rivers and the Maros produced an extremely high flooding of the Tisza, and in the summer of 1974 another abnormally high flood-wave passed down both the Tisza and the Körös rivers. In the summer fo 1975, the Maros set up a new record water level, while in the summer of 1980 it was the turn of the Körös rivers to produce previously unseen water levels, against which the embankments were no longer able to provide protection.

Flooding of the rivers in the autumn occurs only rarely. One year when this did take place was 1942.

The beds of the Tisza and the Maros have developed in sand layers. There are likewise generally sand layers under the several metres thick covering layer of the embankments. This is the reason why water rapidly springs to the surface on the protected side of the embankments at the time of high water levels in the rivers. This gives rise to serious problems in the flood defence work, for the length of the embankments where the subsoil lets through the water in this way is about 200 km for the Csongrád County sections of the Tisza and the Maros.

The old hydrographic maps of Csongrád County depict many areas of dead-water which have since become ploughland. The recent creation of artificial fish-lakes has gone some way to make up for the loss of this dead-water.

The minority of the still existing lakes lie in the one-time Tisza bed, dead-arms formed from meanders cut off when the regulation was performed. Examples include the Dead–Tisza basins at Csongrád, Algyő (Sasér), Nagyfa, Gyálarét, Mártély and Körtvélyes, and the remnant of the old mouth-arc of the Maros between Deszk and Szeged.

Naturally, there are also to be found in the county large, but shallow lakes, the basins of which were not carved out by the old running-waters; these were mainly formed by the work of the wind. In part the wind carried away the dried-out sand, giving rise thereby to a depression from which the water could not run off; and in

Connate hydrogram of Hódmezővásárhely district (after B. Bodnár)

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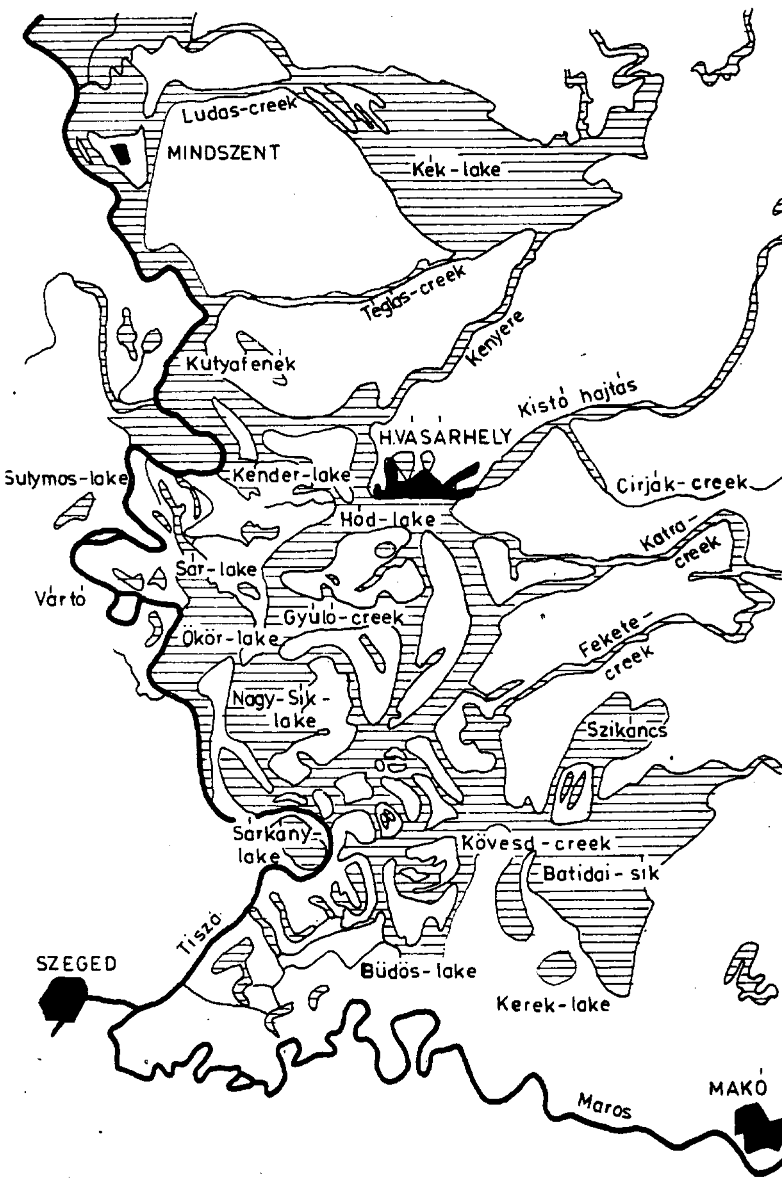

part the wind deposited dust and sand from the air, these deposits in places blocking the free flow-off of rainwater and of soilwater which forced its way to the surface. In many areas, contributions were also made to the final development of the present forms of the lake basins by the process of alkalinification and by the bank abrasion resulting from the wave-cation of the dead-waters.

The best-known such natron lakes in the county are the Fehértó near Szeged (now essentially transformed into a fish lake), the Nagyszéksóstó at Mórahalom, the Széksósfürdő Lake at Kiskundorozsma, the Őszeszéktó at Balástya, the Zákányszék Lake, the Csaj and Dongér Lakes (the latter also known as the Büdösszék Lake) in the protected area of Pusztaszer, and the Péteri Lake (famous as a bird reservation) near Csengele- The largest of these is the Fehértó near Szeged, its area being more than 16 km^2. Of this, 5.2 km^2 is used for fish-farming; the remainder being a periodically expanding and contracting shallow water surface which mainly owes its existence to the fact that only few aquatic plants can live in its alkaline water, and its biogenic filling-up is therefore only a slowly developing process.

Few woods are to be found in Csongrád County *(Fig. 4)*. It is true, however, that most of those which do exist are so famous that they are cared for as nature conservancy rarities. The situation is similar with the once extensive Tisza and Maros flood areas, where the various flood-soils alternate with eroding natron areas and drying-up marshes. Nevertheless, one of the most striking features throughout the county is the excellent agricultural productivity of the diligently worked land. Particularly the eastern half ot the county, and the Békés-csanád loess table-land, are characterized by meadow soils of very good quality, while the western areas, with their sandier soils, are famous for their vegetable and fruit production *(Fig. 5, 6)*.

In connection with fruit production, mention must of course be made of the climate; Csongrád County is usually characterized as an area with a climate that is warm and dry, and in summer very hot. During the first 50 years of this century, for instance, the average number of hours of sunshine annually in Szeged was 2102, which justifies its being known as the "City of Sunshine".

Naturally, the proportions of sunshine vary considerably in the different seasons. The greatest amount of sunshine occurs in the summer, i.e. June, July and August (866) hours), whereas in winter the number of hours of sunshine is less than a quarter of this: 206 hours in December, January and February. The cause of this great difference is clearly the higher cloud coverage in winter, together with the briefer period of daylight, but an appreciable role is also played by fog and mist.

The town with the highest temperature in the county is Szeged, with an annual average of 11.2 °C. (That for Csongrád, which lies more north than Szeged, is only 10.7 °C.) The hottest month is July, with a 50-year average temperature of 22.3 °C. This naturally means that the summer months may be much hotter or much cooler than this. For example, the average of the absolute temperature maxima for July in Szeged is 34.9 °C, while that for the absolute minima is 11.9 °C.

The many-years average coldest monthly temperature for January in Szeged is -1.2 °C, and in Csongrád -1.8 °C. The corresponding values for the other winter months in Szeged are not below freezing point. These numerical data show that the winter in Csongrád County is only a moderately cold one. It must be added that, compared to other regions of Hungary, Csongrád County is also strikingly poor in snow. Winters when the snow cover does not last longer overall than 3 days are fairly common (10% probability in the southern part of Csongrád County.

Wood covered territory of Csongrád county

4.

The autumn too is relatively warm and lasting. The average monthly temperature for October is 11.9 °C in Szeged, and 11.2 °C in Csongrád. Understandably, this is accompanied by the late appearance of the first frosts (only between 1–5 November in Szeged, and in the last days of October in Csongrád).

The many-years average reveals a very low precipitation in the county. The driest region of Hungary is around Csongrád, with the annual precipitation amounting

Geological map of Csongrád county

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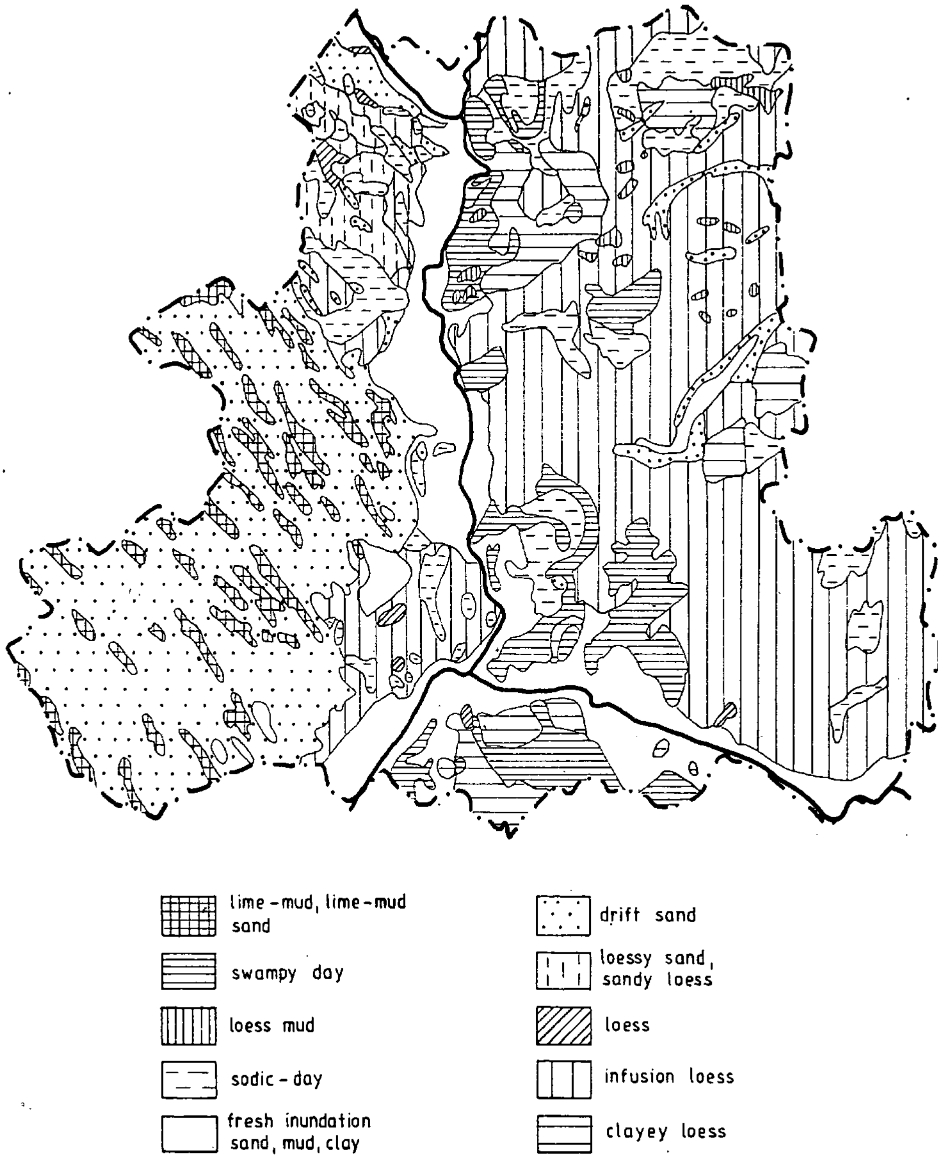

Soil types of Csongrád county

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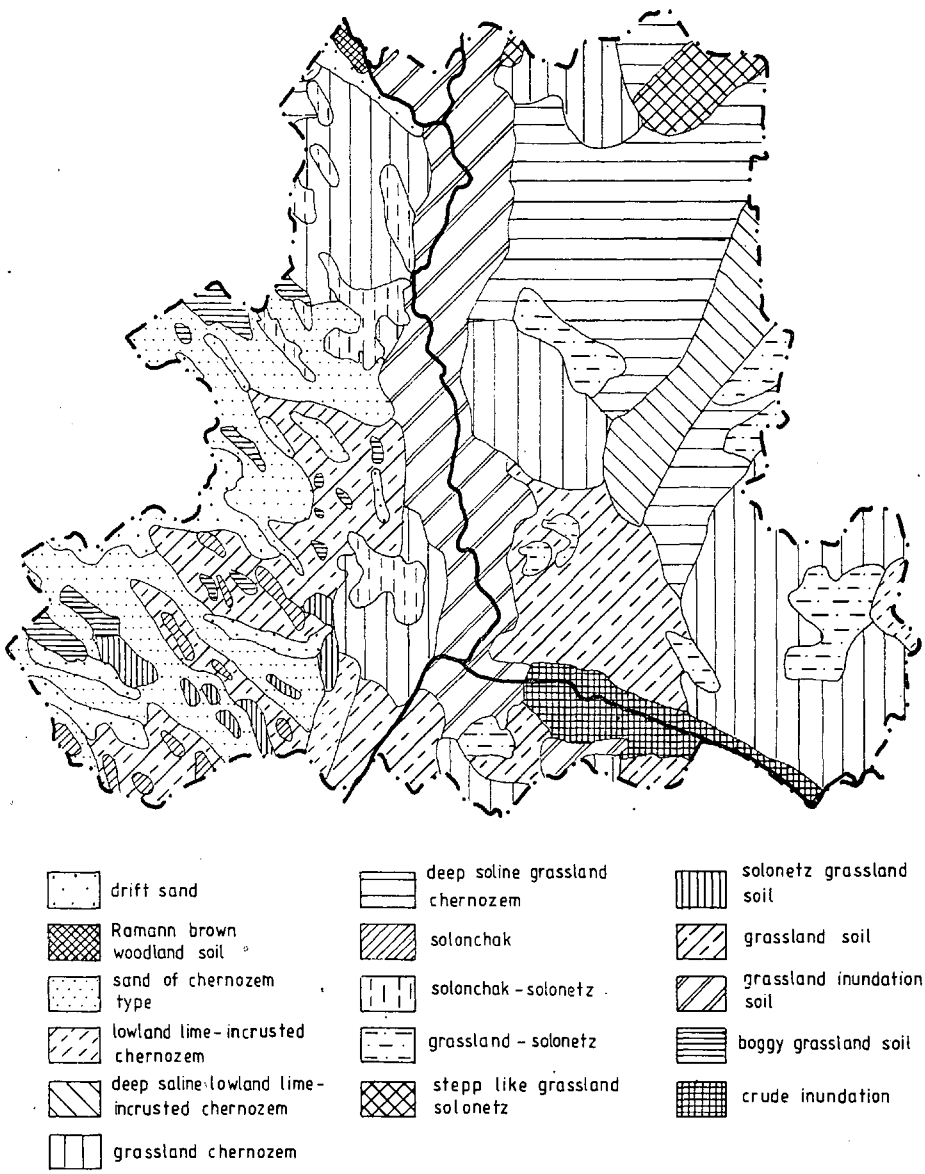

to only 520 mm. In Szeged too the average is only 573 mm, which is well below the mean level for the whole of Hungary. The supply of water in the county is thus a very unfavourable one, particularly because of the extremely high losses of water due to evaporation in the hot, dry summer. The average annual water deficiency around the town of Csongrád is more than 175 mm, and even in Szeged it is about 125 mm.

The most precipitation falls on the county in May and June. During these two months it amounts to 129 mm altogether in Szeged, and 117 mm in Csongrád. The lowest precipitation occurs in January and February; 66 mm for the two months in Szeged, and 59 mm in Csongrád. One February is on record when the precipitation in February was only 1 mm in Szeged, while there has also been a July with only 6 mm.

It follows from the situation of the county at the centre of a basin, far from the hills, that it is not very possible to speak of an outstandingly predominant wind direction. Winds may occur with fairly high frequency from any point of the compass. Naturally, in Csongrád County too the north-west wind is the most common, but in Szeged the probability of such a wind is only 17%, while the probability of a south-east wind, i.e. from just the opposite direction, is 14%.

North winds and south winds are observed with the same frequency: 13% each. An appreciable difference shows up only between the frequencies of west winds and east winds: 12% and 6%, respectively. The southern part of the county is somewhat more windy than the northern part, but overall the wind speeds and the wind energies are lower than the averages for Hungary.

It is clear that the climate of Csongrád County is a very favourable one for tourism, while the abundant warmth and sunshine are of great benefit for fruit and vegetable production. At the same time, the climate can also cause serious problems, mainly in agriculture, for there is a shortage of precipitation in the growing period in particular. For the nationally-known high production results to be attained, therefore, a deciding condition in this region is the large-scale canalization and irrigation.

A knowledge of the natural characteristics of this region, of course, involves much more than merely the "superficial" impressions. An essential factor in the true features of this planar area can not be seen at all on the surface. This is something that scarcely exists in Hungary, or even in other countries in Europe: a tremendous mountain relief that lies hidden below the surface of the landscape.

Following the recovery of oil from the first drilling in the vicinity of Szeged in 1965, the oil geologists carried out a tremendous number of deep drillings in Csongrád County, with the aim of the thorough exploration and production of the hydrocarbon reserves in the deep rock layers. Some of these drillings were only 1–2 km deep, but the ever-improving oil-drilling equipment also permitted the preparation of bore-holes 5–6 km deep. By this means, the sites of richest occurence of mineral oil and natural gas in Hungary have been discovered in Csongrád County. It has also been found that the deep-lying, covered, loose-structured rock layers contain a practically immeasurable quantity of hot mineral water which has therapeutic value. In addition, however, a picture has emerged that far exceeds the previous scientific conceptions: under the surface of the county lie huge basins and heights, the differences between their levels in places being greater than those between the levels of the deepest valleys and highest peaks of the Alps or the Caucasus. A few data may be given to illustrate this.

The substratum of crystalline rocks and geologically old (Palaeozoic–Mesozoic) sediments that was on the surface of this area in the first half of the Miocene Period (about twenty million years ago) is today to be found at a depth of 1090 m at Battonya in Békés County, and at 1629 m at Tótkomlós. At the same time, no sign of it is observed at a depth of 5800 m at Hódmezővásárhely, or at 6500 m between Csongrád and Szentes. At Szeged, one drilling has revealed the ancient surface at a depth of 2550 m, and one a few hundred metres away at 3000 m. The surface has been drilled at numerous sites at the nearby Algyő. In one drilling the substrate was reached at only 2460 m, whereas in another barely half a kilometre away there was no trace of it even at 3700 m. At Makó the substratum was found only at a depth of 4800 m.

Thus, it has emerged that the various rates of movement of the Earth's surface in the different areas of the region that is now Csongrád County have produced relative differences in level of at least 5.5 km within a distance of a few dozen kilometres. For comparison, it may be mentioned that the peak of Europe, Mont Blanc, is "only" 4807 m high.

However, if it is considered that the continuations of the deep-lying mountain chains under the Hungarian Plain are to be found several hundred metres above the level of the Plain in the not too distant Bihar Hills, or the rock mass of the Mecsek Hills, which are of a geologically similar age, it may be seen that large-scale movements of subsidence and mountain formation occurred in the times of the youngest history of the Earth *(Fig. 7)*.

It is not difficult to see that if, by some means, it were possible to remove from the surface of Csongrád County the sediment cover of varying thickness that has accumulated from the alluvia deposited by the rivers flowing in from the adjacent mountains at the beginning of the sedimentation, at the time of the Sarmatian and then the Pannonian Sea, and continuing right up to the present day, Csongrád County would at once become a European centre of alpinism.

Of course, even with the technological possibilities of the twentieth century, such a reconstruction of the landscape can be only an illusion, for it would be necessary to remove merely from the surface of the county about 15,000 km^3 of sand, mud, marl, gravel and various types of limy sediments. (As an illustration of the immensity of this quantity, the total amount of water in Lake Balaton does not attain even 2 km^3.)

Even if it were possible to carry away this deposit, what would be the pointä? The resulting enormous valleys would be filled again, first with the inflowing rivers, and then slowly with the solid alluvial material again.

The rivers reaching the area of Csongrád County rise virtually without exception in high hills and mountains, and over a long period they have been transporting to this area huge quantities of sediment in the form of rock debris, clay, sand, etc. This is especially true in the periods of flooding of the rivers, when the speeds of the flows and their transporting capacities are many times higher than at other times.

It has been reported by Romanian research workers that the average value of the specific erosion in the water-catchment areas of the tributaries of the Tisza in Romania is 1 tonne (hectare) year. This means that 40 m^3 of soil or rock debris is washed off every square kilometre of the catchment slopes there annually, and is then transported by the water into Hungary. This itself is a huge volume of alluvium if it is considered that the total catchment area of the Romanian tributaries of the Tisza is 61,890 km^2, so that about 2.5×10^6 m^3 alluvial material would be washed

Basin - bottom map of Csongrád county
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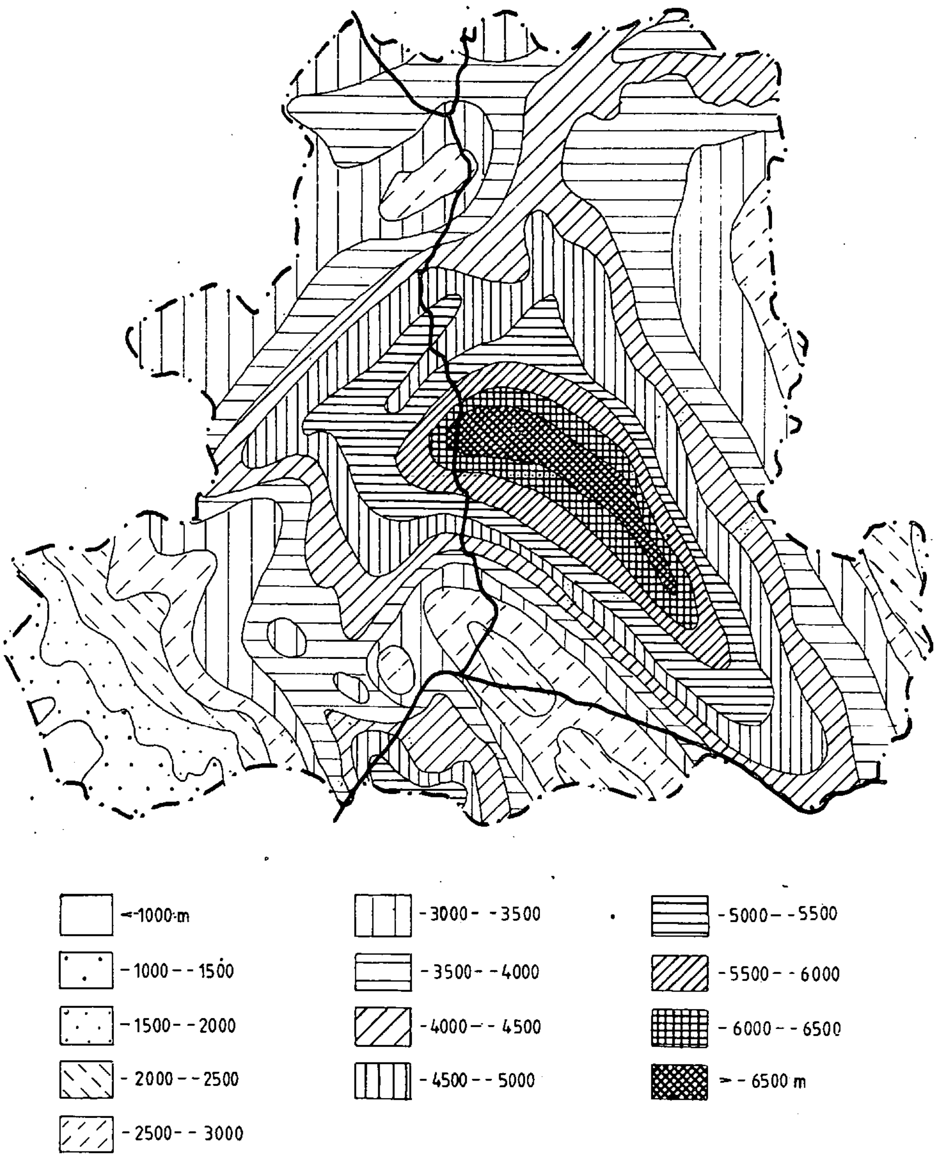

into Hungary annually. However, measurements in Hungary point to the fact that the extent of alluvial transport is even higher than this. At Deszk, for instance, the Maros is responsible for the transport of 4.63×10^6 m^3 suspended or rolled alluvium each year on average. Measurements on the Tisza alluvium indicate that at Szeged this river transports more than 12×10^6 m^3 rock debris, sand and mud annually. Naturally, the rivers reaching the Hungarian Plain from the slopes in Czechoslovakia also bring with them an immense amount of material.

It is fortunate, therefore, that a considerable proportion of this vast quantity of alluvium is transported beyond Hungary. Nevertheless, the various measurements and calculations have demonstrated that, even so, in the periods before the protection against the flooding the Tisza and its tributaries deposited an average of about 4.5×10^6 m^3 alluvial sediment each year onto the Hungarian Plain.

A fairly large proportion of this enormous amount of sand and mud was deposited onto Csongrád County, for this area has always been one of the fastest-subsiding basin areas of the Plain. This extensive import of sediment was the only means whereby the continuously subsiding trough of the Hungarian Plain could remain as land, and not as a large lake; the rivers constantly changed their beds and their flow directions, and always transported their alluvium to where it was most required: the most appropriate sites of subsidence and the sediment traps.

A problem that is already perceptible in Csongrád County, but will become more serious in the future, is that the area is continuing to undergo subsidence, but the rivers are no longer able to compensate this with any natural filling-up process since they are now confined within their embankments. In the areas of Csongrád County that have been freed from extensive flooding, the natural filling-up of the terrain was decisively terminated about 200 years ago.

Now, therefore, the mass of alluvium which is still brought down constantly by the rivers can only be deposited on the narrow strips of flood plain between the embankments; this means that the rate of the filling-up process here has been multiplied considerably. After each major flood-water goes down, it may now be observed that a new layer of mud several cm or even dm thick has formed on the flood plain. These fresh accumulations of sediment are layered one on another and from year to year raise the level of the soil on the flood plain; this is accompanied by the narrowing of the cross-section of the channel carrying off the flood-water, and hence increases the danger of flooding. Fortunately, through dredging and the elevation of the embankments, this danger has been successfully met for the time being.

The uncompensated subsidence of the basin may become the source of still other problems in this county. The prolonged elevation of the soilwater level is to be expected, for example, and even the increase of the areas subject to inland flooding.

Of course, all these problems can be solved, for man is already able to drain huge areas of lakeland via the construction of appropriate canalization networks. Nevertheless, these are interesting problems that give cause for deep thought; they are not sensed at first sight, but they are unavoidable factors accompanying the characteristic geological and geographical features of the Csongrád Basin, and they affect the lives and society of the people dwelling here. Although the region may appear quiet and peaceful, it contains the seeds of great danger.

The several thousand metre thick strata of young sea- and river-borne sediments that have accumulated on the area of the county conceal a mineral treasure bearing a very appreciable quantity of energy. The richest sites of occurrence of mineral oil and natural gas in Hungary have been discovered in the thick neogenic sediments in the vicinity of Szeged. The layer traps containing considerable hydrocarbon reserves mainly lie on the western side of the Makó Trench, e.g. the hydrocarbon fields at Algyő, Ferencszállás and Szank, and also the productive structures at Szeged, Dorozsma, Ásotthalom, Öttömös, Üllés, etc.

It is highly probable that the oil and natural gas generally found in the Pannonian strata at depths of 1600–30000 m predominantly migrated up from the older geological formations in even deeper positions. The hydrocarbons are capable of migrating over considerable distances in the pores in the layers, and numerous signs indicate that these oil derivatives (at least in part) originated in the rock layers from earlier ages.

This assumption appears to be supported otherwise by the fact that, within the area of the county, mineral oil has been found in the old (Palaeozoic–Mesozoic) formations of the substratum, and even at fairly great depths below the Pannonian sandstones. It is not excluded that, in the near future, when an ever greater number of drillings have been made to depths of 4000–6000 m, the hydrocarbon situation in Csongrád County will be seen to have been enriched by further substantial geological reserves.

Another natural treasure of inestimable value in the county is the extremely rich supply of thermal water. This was discovered comparatively long ago, for the wells of soilwater from close to the surface never provided healthy drinking-water for the local population, even when these wells were situated well away from areas of flooding or from other means of contamination. As a result, in the 19th century considerable efforts were made to obtain pure water really suitable for consumption from the deeper layers, where it can in no way be polluted by the surface chemicals and bacterial pathogens. The first artesian well designed for public use in Hungary was drilled in Hódmezővásárhely by Zsigmondy Vilmos in 1879–80, at the expense of Nagy András János. The fruit of this was the widespread drilling of further artesian wells throughout Hungary.

It turned out that wells with an ample supply of water of excellent quality could be bored throughout the county at depths of 200–250 m (mainly fed from Pleistocene fluviatile sand layers). It also emerged that, still deeper, mainly the Pliocene and Upper-Pannonian layers contain a great abundance of hot mineral waters of various temperatures and chemical compositions. Hungary first became aware of this when the geologist Pávai–Vajna Ferenc drilled the Anna Well in Szeged, one of the first thermal wells in the country; this was followed by a large number of other thermal water wells. Some characteristic data on the drillings providing the most important sources of medicinal and thermal mineral water in the county are given in the Table.

Few people know that Csongrád County was also in the forefront as concerns the direct utilization of geothermal energy for heating purposes. The hospital in Szentes was the first institution in Hungary to be heated in this way; naturally-occurring hot water was led into its radiator network even before the Second World War. Even from a European aspect, the first town-quarter to be heated directly by geothermal energy was built in Csongrád County: the Odessa housing-estate in Szeged, in 1964. Since that time, the energy of the heat of the Earth has been used to produce primeur fruit and vegetables on a large scale at many places throughout the county, by the heating of green-houses made from glass or plastic sheeting, though the possibilities available for this have still not been fully exploited as yet.

THE MOST IMPORTANT MEDICINAL AND THERMAL WATER IN CSONGRÁD COUNTY

Site of drilling	Depth of water-giving level m	Age of water-giving level	Water yield, litres/min	Water temperature °C	Chemical nature
Csongrád, swimming-pool well	925—1007	Upper Pannonian	1200	46	
Hódmezővásárhely, swimming-pool well	751—1092	Upper Pannonian	1300	43	simple thermal
Vajhát	655— 720	Upper Pliocene	560	34	
Marx Cooperative Farm	1535—1893	Upper Pannonian	2000	71	
Makó, swimming-pool well	755— 886	Upper Pliocene	1120	42	alkali-hydrogencarbonatic
Mindszent, Tiszavirág Cooperative Farm well	2475—2535	Upper Pannonian	1100	42	alkali-hydrogencarbonatic
Mórahalom, swimming-pool well	568— 642	Pleistocene	550	39	alkali-hydrogencarbonatic
Szeged, Anna well	936— 953	Upper Pliocene	455	49	alkali-hydrogencarbonatic
swimming-pool well	520— 649	Pleistocene	570	37	alkali-hidrogencarbonatic
Felszabadulás Cooperative Farm	964—1009	Upper Pliocene	1130	53	hydrogencarbonatic
Székelysor	1750—1866	Upper Pannonian	1500	89*	alkali-hydrogencarbonatic
Haladás Cooperative Farm well	910— 991	Upper Pliocene	2000	52	simple thermal
Clinics	1727—1914	Upper Pannonian	1760	90*	alkali-hydrogencarbonatic
Szegvár, hemp factory	591— 896	Upper Pliocene	1200	36	alkali-hydrogencarbonatic
Szentes, hospital	1633—1675	Pannonian	1600	78*	alkali-hydrogencarbonatic
Árpád Cooperative Farm well Farm well	1809—1983	Upper Pannonian	1800	91*	alkali-hydrogencarbonatic

* hyperthermal waters