SZÉNHIDROGÉNEINK VÁNDORLÁSÁRÓL.

Irta: *Dr. Schmidt Eligius Róbert.*[*]

ON THE MIGRATION OF HUNGARIAN HYDROCARBONS.

By E. R. Schmidt.

The problems to be found on the course of the search of hydrocarbons can be distributed in three lines: into the problem groups of mother rock, of migration and of accumulation of hydrocarbons none of wich seems for the time being finally cleared; many points here and there await further investigations.

The problem of mother rock was newly touched by Director Lóczy and Ferenczi. Lóczy mentions chiefly the Oligocenic (fish-slates of the lower Oligocenic, foraminiferous marl of the lower Oligocenic, Kiscell clay wich latter could even be mother rock of salt also) as most probable origin of mother rocks of Hungarian hydrocarbons He emphasizes, however, that also the foraminiferous marls of the Eocenic, eventually the bitumenous limestones of Cretaceous-flis and Paleozoic sediments can play some role. Ferenczi sees the origin of our salt waters genetically combined with hydrocarbons in the regressive periods between the Sarmata and lower Pannon horizons, in the Aquitanien, so-called infra-Oligocenic, Paleogenous danien, eventually in smaller ones at the beginning of Eocenic. He further supposes that at least a part of them takes its origin of Mezozoic and Paleozoic layer groups.

As for the problem of the stratigraphy of accumulation a lot of valuable observations has been collected. The sandy rocks of lower Pannon, Mediterrane, etc. proved e, g. to be definitely accumulative ones. The anticline, as a structural form stands on the first place as regards accumulation.

Hugo Böckh was the most ardent Hungarian propagator of the anticline theory published in 1861 by the American Hunt Sterry which spread in Europe after 1876 on the basis of Hoefer. The anticline theory had for a time almost a monopoly until its rule has been weakened by some foreign authors (e. g. Sommermeier, Waagen, etc.) who implied some accumulative role to higher lying fractured clods.

Now I deal with the problem of migration which has already been much discussed by foreign authors but strikingly less by inland experts.

It is interesting to observe that most part of the gaseous wells of the Hungarian Plain lie within the same zone beginning northly on the borders of the Plain quite at the feet of the Mountains Bükk and Eperjes-Tokaj and extending to south as far as Temesvár. This zone includes the area of the gaseous wells mentioned by István Pazár as gas-filled territories of „Marosvidék", „Tisza-

[*] Ez az értekezés magyarul a Bányászati és Kohászati Lapok 1934. LXVII. évf, 19. sz. p. 423—426. o. jelent meg.

Berettyóköz" and the third one, lying almost as a connection of the previous ones, characterised by the gas occurrences of Szarvas, Orosháza, and Békés. This area is followed to north by the territory including the more significant gaseous wells at Debrecen, Hortobágy, Hajdúszoboszló and Tiszaörs, further the gas occurrence at Tiszalök and the bitumen occurences of Bogács and Tard on the

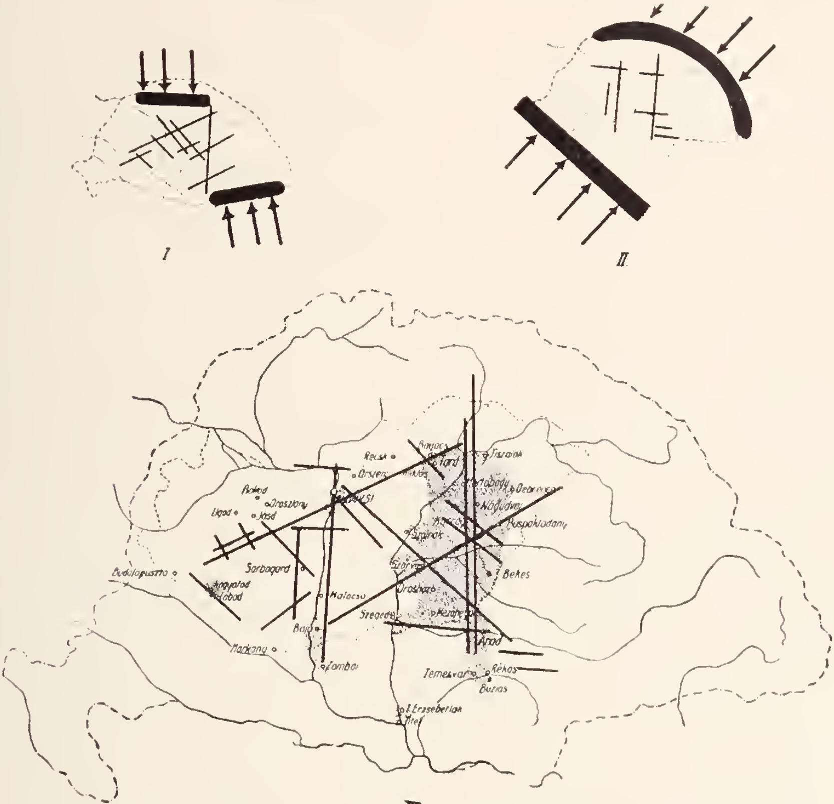

Fig. 30. ábra.

EXPLANATION OF SKETCH.

I. Direction of mountain forming forces in the middle and end of the Cretaceous (signed by arrows), the zones of folded mountain chains Fátra and Tátra zones, Transsylvanian Alps (signed by strong black stripes) and the directions of fracture lines caused by shear, respectively by pression forces within the solid clod of the Hungarian median mass (signed by strong black lines).

II. Direction of mountain forming forces (generally speaking) on the limits of Oligocenic-Miocenic, the folded orogenous zones (zone of Kárpát sandstone and Dinaridae) further the direction of fracture lines formed within the Hungarian median mass.

III. Area of gaseous wells on the Plain (dotted territories) and other more significant occurences of gas and bitumen (signed by village names) and the connection of fracture lines.

other side of the Tisza. The above mentioned area forms a zone maximally 70—75 km broad and about 250 km long. The definite north-south direction of this zone strikingly signs the organic continuation of the tectonical line known as the chief large dislocation line of Hernádvölgy.

The correspondence of these lines is not a chance but a mathematical obligation. I already emphasized in my geomechanical studies that the Hungarian median mass has been worked under the course of the mountain formation of the Kárpát by shear forces in this direction. The result of these forces should naturally be the ruptural deformations of north-south direction (about the eastern borders of the Plain). The importance of this structural line is yet affirmed by the fact that it is here crossed by the diagonal fracture lines which without doubt exist also on the Plain (in NE—SW direction and vertical to it). The line of these crossing points is on the whole a N—S line forming the above mentioned „Schwächen-Zone" (weak zone).

Another gaseous line corresponding to a tectonical direction is the Danube line from Budapest to the Dráva mouth and will perhaps be also the line of the river Dráva. Also such can be partly the longitudinal fractions mentioned by Lajos Lóczy sen. along the Balaton the NE direction of which can be following almost as far as to Hegyalja. Similar observations can be made on many cross fractures also.

The correspondence of the above mentioned and other fractures, fracture zones and gaseous areas makes probable some existence of correlativity between them. It is very probable that the gases migrated and migrate even nowadays along these lines to the higher layers of the Plain.

The possibility of migration is affirmed by the fact that here and there we found gaseous salt waters not only in Pannon Caspian brack, but also in freshwater and land formations, even in Pleistocenic sediments.

Many investigators affirm the theory that fracture lines serve in the first line as ways of traffic and channels. Thus Hempel, Krejci-Graf, Mrazec (torn open diapir folds!), Popescu-Voitesti as regards the Roumanian, Friedl, Musil, Waagen the Austrian, Sommermeier the Czechoslovakian, Friedl, Miaczynsky the Galician, Diacourt ver Wiebe some American and Strztelski the Caucasian oil territories. Of Hungarian investigators I can mention the observations of Sümeghy on the geothermic gradients on the Plain, the newest statements of Ferenczi and the respective ascertainments of Lóczy.

The regional migration on large surfaces must besides remain insignificant because of the thick and practically impermeable layers of clay and marl. The migration of gases through such layers cannot be explained by capillarity nor by diffusion nor the high differences of pressure. Any communication can be supposed only by the fractures staying open for longer or shorter periods. Chiefly this must be the cause why the waters most rich in gases of the deep borings on the Plain take their origin of a lower Pannon sand covered by several hundred meters large clayey Pannon sediments into which the former was interlocated. E. g, the borings at Debrecen, Hajduszoboszló, Kareag, Tiszaörs etc.

Taking it as probable that fractures could exist in some more plastic rocks only for shorter periods we must emphasize that some ones at least should have been remained open until the oil hardened to earth wax (Boryslaw). Krejci-Graf mentions a shaft of 5 meters diameter and 290 meters depth located in Pontic clay in Roumany which remained open for days without any fixation and could have remained so even longer. The solidity of younger clayey rocks is affirmed by the example of a boring located in 1912 in the court-yard of the protestant school at Rákospalota. As Károly Papp describes, the boring gave gaseous salt water at about 183 meters depth out of lower Mediterraneous layers. After the exclusion of this water the boring was deepened in Kiscell clay to 405 meters without any success and the pipes were taken out of the depth 405—183 meters. After 21 years in 1933 the boring was again examined and the 183 meters deep pipe was found to be movable and the hole quite untouched.

The border firm Mazalán stated that salt water existed within the hole and silt was found lower than 395 m only.

Fractures acting as communating channels in the past or in the present are not at all rare not only in the rock bottoms of basins but also within the tertiary layers wich fill them up. This is affirmed by the mine profiles of Károly Papp, Pál Rozlozsnik, Károly Telegdi Roth, Zoltán Schréter, Jenő Noszky etc.

Many investigators made examinations to prove how deep could spread such fracture lines and cracks in the solid earth crust. The result is that they can serve as communicating channels for above moving hydrocarbons in a much larger measure as wanted. A. Heim (1878) supposes 3000—4000 meters on base of the geothermic gradient, Hoskins, however, states that empty cracks may extend to about 6000, those filled with water to about 10000 meters. According to Van Hise (1900) the plastic zone of the solid earth crust should begin under 12000 meters. F. D. Adams (1912) affirmed by experiments and L. V. King by theoretical calculations that smaller cracks and holes can be open even in a depth of 18000 meters.

I would affirm by the above statements my theory described in a report of mine in 1933 that namely the Hungarian hydrocarbons and salt waters migrate in the first line along the fracture lines from mother rocks to lower pressure points. The high mount forming and rock pressure forces them out of our peliteous mother rock and sends them to migrate. L. F. Athy stated as a result of the examination of 2200 clay samples that the porosity of freshly sedimented clay is 45—50% against the 30, 20 12.5, 8, 5, 3 and 2.5% porosity of clays originating of depths of 300, 600, 900, 1200, 1500, 1800 and 2100 meters. The migration activity or the beginning of migration may be caused besides by difference of temperature or change of specific gravity of thermal origin,by diffusion, by the overturning of the statical balance by separated and expanded gases, etc.

It is characteristical that most part of our gaseous wells and bitumen occurrences are located along directly observed or theoretically supposed fracture lines and they used chiefly the crossing points of fracture lines as communicating lines similarly to the ore forming vapors and gass or volcanic eruptions and their accompanying phenomena: the solfataras and mofettas. They migrated along these channels as lines of the smallest resistance and elevated saturating (according to their smaller or larger saturation and permeability resistances) the crossed porous rocks. As a result they naturally accumulated in the low-pressure spots, in brachyanticlines eventually within elevated clods. Thus the migration along fractures gets combined with the lateral one and the gas impregnates and diffuses in the meantime. The lateral migration, however, is limited by the fact that the porous sands occur only in the form of smaller or larger lumps in the structure of the subsoil of the Plain being surrounded by interlocated clay.

This fact (besides the problematic location circumstances of the mother rock) makes the more or less acute territorial limitedness of our hydrocarbon occurrences understandable. It further makes it reasonable that an increased attention should be paid to the fractures amongst the searched structural elements in case of particular investigations.

IRODALOM — LITERATUR.

1906. Pazár István: A magyar Alföld természetes gázgyárai. Magyar Mérn. Épít. Egylet Közlönye.
1912. Papp Károly dr.: Az őrszentmiklósi gázkút. A Bánya, VII. máj. 5—8. szám.
H Hoefer: Das Erdöl u. seine Verwandten. III. Aufl. Braunschweig.
1928. Gaál István: A kincstár alföldi mélyfúrásai. Term. tud. Közlöny. Potfüzet 4. sz.
1929. Sümeghy József dr.: Die geotermischen Gradienten des Alföld. Földt. Int. Évkönyve.
Walter A. ver Wiebe: Tectonic classification of oil-fields in the United States. Bulletin of the American Association of petroleum geologist.
1930. K. Krejci-Graf: Grundfragen der Ölgeologie. Verlag v. F. Enke in Stuttgart. Vol. 13. Nr. 5.
1932. Schmidt E. R. dr.: Eine theoretisch-mechanische Deutung der europäischen Bruchsysteme. Neues Jahrbuch etc. B.