EUGEN ANGELESCU - THE FOUNDER OF "ROMANIAN SCHOOL OF COLLOIDAL CHEMISTRY"

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MOTTO

It must permanently be said that the scientist is not ever trained by a solitary experience. He gets from the predecessor's knowledge, way of thinking, position.

Eugen Angelescu

Prof. EUGEN ANGELESCU was born on January 4th, 1896 at Râmnicu Vâlcea, Romania. There he attended the classes of primary and secondary school. He attended the high school inside the Department of Sciences of University from Bucharest, which he graduated with excellence in 1918. The First World War marred his studentship. He was sent to Jassy to The Military School of Engineer corps and then in active combat; meanwhile he passed his examinations.

He got his BS in physical-chemical sciences and joined the staff of agricultural chemistry chair of Bucharest University in January 1919 as an assistant.

Between 1920 and 1922 he carried out remarkable studies on ether oils at the University of Rome, Italy under the supervision of Prof. E. Paterno; the results made up the subject of his Doctoral Dissertation which was *appreciated "cum laude".* At the same time he improved his teaching skills attending classes of organic, physical and pharmaceutical chemistry given by the professors Canizzaro, Paterno and Leone, respectively.

He returned to Romania in 1922 and resumed his activity at the University of Sciences, Bucharest, holding teaching positions of associate professor (1926) and professor (1936).

In 1929 he was awarded the title of Doctor of Science and taught the first course of Physical Chemistry. In 1032 he was elected General Secretary of Romanian Chemical Society and in 1936 he became the chairman of Organic Chemistry Department, position which he held until the end of his life. In 1938 he was elected as Corresponding Member and in 1953 Member of Romanian Academy.

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In 1940 he published *"Introduction to Physical Chemistry"* second treatise of it issued in our country (the first had been issued by Prof. Petre Bogdan from Jassy University) in 1929.

His research activity was influenced by his erudition in physical and organic chemistry. He became a pioneer of organic chemistry and the founder of Romanian School of Colloid Chemistry. From his remarkable contributions we mention:

Adsorption phenomena and the partition between two phases
He established the existence of a close relation between the adsorbent solubility in solvent and its adsorption on coal.

He has proved that the iodine's adsorption on starch, depending on the potassium iodide concentration, does not depend on iodide concentration because the iodine is adsorbed as a combination with potassium iodide [2].

The study of binary and ternary systems relating with the hydrocarbon solubility in solvents mixtures, the critical point of solubility
He started from the idea that the shape of the solubility curve of some substances in solvent mixtures could give information on the phenomenon, which are accompanying the dissolving (associations, combinations, dissociation etc) by deviations from additivity.

Studying the solubility of picric acid in solvent mixtures of some benzoic substituted acids, trifenols or aliphatic alcohols in solvent mixtures, he came to the conclusion that, in case of curves with maximum, the dissolved substances could form combinations with one of the solvents [3, 4].

In another series of researches he measured the solubility of hydrocarbons in dissolvent, which possess a permanent electric moment and which, in consequence, possess a selective dissolving power for different classes of hydrocarbons [5].

He has determined the curves and the equilibrium surfaces between two liquid phases in case of over 200 binary and ternary systems.

His conclusions concerned the following:

- the selectivity of polar solvents for hydrocarbons and the applicability limiting values of the analytical methods recommended in literature for the study of hydrocarbon mixtures (oil fractions) based on the aniline point or, generally, based on the critical point of solubility [6, 7].
- -upon the nature of molecular combinations of aromatic amines with aliphatic acids (heteropolar or homeopolar) [11-13].
- by studying the properties, that depend on the free space between molecules (ex.: volume contraction, superficial tension, parachor, refraction index, molecular refraction) he draw the conclusions upon the nature.

The study of the nature of sucrose and calcium oxide combinations
Applying the methods of colloidal chemistry he hadin fact, proved that many of described combinations are, mixtures of sucrose or calcium oxide with tricalcic succrate, that are in advanced dispersion stage [8].

Based on some kinetic studies made upon sugar extraction from pure sucrose solution or in the presence of electrolytes he elaborated the mechanism of calcium succrate formation, with application at the improvement of Steffen procedure of "the melase desacharification with calcium oxide", for the purpose of increasing the extraction yield.

For these researches he won the prize *"The Association of Chemists from France"*, in 1936, and was elected as member of the *"Maison de la Chimie"* Society.

Introduction of *"furfurol point"* as a new constant for vegetal oil [14] that helped classifying the oils as: nonsicative, semisicative and sicative [15].

The research domain, that has captivated Eugen Angelescu, was that of colloidal chemistry.

Since 1930, in his lecture of Physical Chemistry he presented a chapter entitled *"The heterogeneous dispersed colloidal systems".*

He inferred with clearness the importance of colloidal chemistry for modern economy.

His researches were directed on the study of organic colloidal systems, treating the relations between the physical-chemical properties and the dispersion degree.

In this goal, he has studied the organic association colloids of high fatty acids salt type.

The first paper, which made him famous in this field was published in 1930, in Kolloid-Zeitschrift entitled *"Contribution on colloidal chemistry of the soap-cresol-water system"* [21], in which he underlines for the first time a phenomenon, that is known today as *"The Angelescu Effect"*, name that entered the worldwide scientific circuit at the XVIth International Congress of the History of Science", which took place in Bucharest in august 1981.

In essence this effect consists in a double solvatation action, according to Ostwald and the dispersion theory, exerted by the addition of a lyophilized substance upon the colloidal systems; the phenomenon is visualized by the appearance of a maximum of viscosity, according to the addition's concentration (Fig. 1) [22].

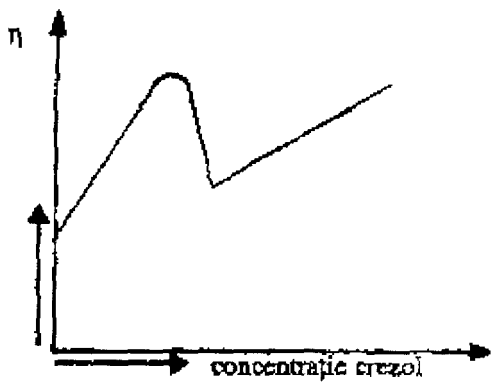

Fig. 1.

High fatty acids' salts form dispersions that are gradually changes from molecular solutions to colloidal systems

The properties of soap cresolate solutions are varying in a specific way, depending on the amount of added cresol, the viscosity passing through a maximum and the superficial tension reaching a minimum (Fig. 2) [23].

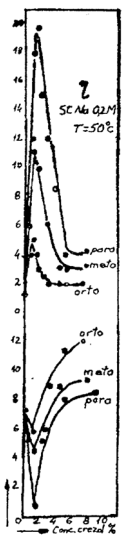

Fig. 2

The maximum is as pronounced as the solution is more concentrated and the temperature is lower, the hydrocarbon chain is longer and depending on the cresol's isomery, varies as it follows: orto-, meta-, para- [24].

Later, these papers were completed by the study of saturated acids' salts with 8-18 carbon atoms, with and without electrolytes having common cation, studying the influence of hydrocarbon chains, which include double bonds, an OH group or studying the influence of *cis-trans* isomery upon the rheologic properties of these electrolyte association colloids [25].

The appearence of the structural viscosity to cresolate solutions of sodium oleate pleads for anisodiametrical form of the micelles, the system presenting a pseudoplastic flow and tixotropic properties [26].

Another characteristic property studied is the electric conductibility, important especially for determining the critical micelle concentration. The addition of polar compounds cresol type produces the dispersion of the electrolytic colloid, a rise of the electric particle numbers, which are able to conduct the electric current [27]. As a result, the electric conductivity rises, reaches a maximum plateau, to a certain cresol concentration (larger than the one corresponding to the maximum of viscosity), after that decreases slowly. The study of electric conductivity in various experimental conditions, varying the factors that influence the system's lyophilic/lyophobic character evidenced a histeresis phenomenon, particularly in the gel state.

The gellification hysteresis was studied according to the turbidimetry, emphasizing three stages in gellification process, which characterizes system's state from the point of view of its capacity to form either lyophobic gels (coagels) having a pronounced recrystallisation tendency, or at the limit, soils that are not gellified under the same temperature conditions [28].

These researches allowed the classification of disperse lyophilic from lyophobic systems. The lyophilic or lyophobic grade of some systems is not fixed, but it is determined by the quantitative ratio (φ) between the volume of the dispersed phase and the volume of medium dispersion and by the mutual solubility between the present phases: [28].

Systems with mutual solubility

completely (φ has any value);	limited;
-homogeneous system	φ under the miscibility's limit value:
-liquid mixture	*-solution with solvatation molecular*

complexes, hydrates

φ over the miscibility's limit value:

-lyophilic heterogeneous system

Systems with unilateral solubility

φ under the limit	φ over the limit
-homogeneous system, solution without solvatation, molecular dispersion	-lyophobic, heterogeneous system

It could action either upon the interaction's dispersed phase or upon the dispersion, either upon the quantitative ratio between phases. In both cases, the properties of the system will be hardly modified.

The phenomenon emphasizes through a maximum of viscosity concomitant with a minimum of surface tension, depending on the concentration of liophylisation agent added to a colloidal system has been described as *"Angelescu phenomenon" a*nd presented by his disciples at "*The XVI*th *International Congress for Science History"*, from Bucharest in August 1981. The explanation consists in the double action of solvation and dispersion that a liophylisation agent exerts on the colloidal solution.

This effect pointed out for the first time by Eugen Angelescu, has been cited in many treaties and papers in this field being appreciated by great personalities such as: M.E.Laing, Mc Bain, E. Huttchinson or W. Phillippoff.

Though this was the starting point for some serial of researches made by colloid schools of those times, driven by J. W. Mc Bain, Per Ekwall, A. M. Bose or A.T.C. Lawrence, unfortunately he can't be found today in any of modern books for colloid science.

Prof. Angelescu's sustained scientific activity has materialized in about 200 papers; he supervised the graduate studies for more than 50 students, issued physical chemistry handbooks (1940), organic chemistry part I (1948) and theoretical organic chemistry problems (E.Angelescu and F.Cornea 1969).

Prof. E. Angelescu was membre of scientific societies: Kolloid Gesellschaft, Maison de la Chimie, Association des Chimistes de France, Commission International des Industries Agricoles - Netherlands.

Member of Academy, General Secretary of Romanian Chemical Society, Director of the Institute of Technological Research, Deputy Director of the Organic Chemistry Center of Romanian Academy, adviser and professor at the Military Academy, Dean of Chemistry Department and Vice-president of the University of Bucharest, Prof. Eugen Angelescu was highly appreciated, esteemed by Romanian scientists and culture men and by personalities in the whole world: Wo.Ostwald, P.A.Rehbinder, max Bodenstein, Swietoslawski, Nikitin, Liesegang, with whom he maintained a permanent contact (kept in touch).

Throughout more than half a century Prof. E.Angelescu has tirelessly conducted a prodigious teaching and research activity; he taught tens of generations of chemists the scientific performing experimental accuracy. He created in Romania a tradition of studies

on colloids and set the foundations of Romanian School of Colloidal Chemistry, which was continued by his successor.

Besides, he was an exponent of Romanian culture and a militant for the peace.

When in 1957 he was solicited by Linus Pauling to ask the Romanian scientists the signatures for an appeal to ban atomic weapons and their removal for preventing an atomic war, Acad. Eugen Angelescu accompanies it with the following vibrant words:

"*The cultural goods of the humanity won by art, poetry, philosophy and science, are shining over the centuries and give the content and value to the life. The war not only destroys the cultural values of the humanity, which were hardly won, but hits even the human being, degrading it. Everyone who loves MANKIND and wishes his promotion must fight without rest and hesitation not only against the war, but even against all the facts which might create a tension and continuous anxious atmosphere.*"

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Senior Researcher of first degree - Disciple and coworker

REFERENCES

1. LEONE, P. and ANGELESCU, E., Gazz Chimica Italiana, 51B, 1921, p.386, 391; 52A, 1922, p.61, 152, 157
2. ANGELESCU, E. and MIRCESCU, J., Bull. de Chim. Soc. Roumaine de Sciences, 26, 1923, p.30; Bull. Soc. de Roumaine, 20, 1939, p.197
3. ANGELESCU, E. and DUMITRESCU, D., Bull. de Chim. Soc. Roumaine de Sciences, 26, 1923, p.26, 71; Zeit. Für Physikal. Chemie, 132, 1928, p.217; 138, 1928, p.300
4. ANGELESCU, E., and MOTZOC, D., Bull. Soc. de Chimie de Roumanie VII, 1925, p.11, 72, 78; IX, 1927, p.18; C.R. Acad. Sciences Roumaine, 3, 1938, p.171
5. ANGELESCU, E., and ZINCA S., Bull. Soc. Sci. Acad. Roumaine, 23, 1941, p.515; 24, 1941, p.106, 167; 25, 1943, p.337, 421, 473,, 515; 26, 1943, p.25, 123; 26, 1944, p.453; 27, 1944, p.60, 70; 29, 1946, p.221; Revue de Chimie Acad. RPR, II, 1975, p.35, 41
6. ANGELESCU, E., Bull. Soc. de Chimie de Roumanie, X, 1928, p.14, 160, 183
7. ANGELESCU, E. and COM~NESCU V.N., Kolloid Z., 50, 1930, p.114; C.R. Acad. Sciences Roumaine, II, 1938, p.140, 143; Zeit. Für Physikal. Chemie, A 177, 1936, p.263
8. ANGELESCU, E. and VL~DESCU, C., Zeit. Für Physikal. Chemie, A 156, 1931, p.81; Bull. Association Chimistes France, 52, 1935, p.374; 54, 1936, p.910; 59, 1924, p.13, 215; Bul. Stiin]ific Academia RPR, seria Chimie II, 1949, p.189
9. ANGELESCU, E., and POPESCU, V.D., Bull. Soc. Chim. Roumaine, 14, 1932, p.25
10. ANGELESCU, E. and CRISTODULO, L., C.R. Acad. Sciences Roum., 1, 1936, p.85; 2, 1938, p.143
11. ANGELESCU, E. and VASILIU, G. and RADVAN, S., Bull. Soc. Acad. Roumaine, 22, 1940, p.411
12. ANGELESCU, E. and GIUSC~, R., Zeit. Für Physikal. Chemie, 191 A, 1942, p.145
13. ANGELESCU, E. and HÖLSZKY, C., Bul. Stiina. Acad. RPR, Sec. St. Tehnice si Chimice, 3, 1951, p.185; 4, 1952, p.129, 179; Analele Univ. "C.I.Parhon", 11, 1956, p.113; 12, 1956, p.77
14. ANGELESCU, E. and ESANU, F., Bul. Stiint. Acad. RPR, Seria Matematica, Fizica, Chimie, 2, 1950, p.387; 3, 1951, p.239; 4, 1952, p.359
15. ANGELESCU, E. and ALBU, C. Revista Universitatii "C.I.Parhon", nr.2, 1953, p.72

16. ANGELESCU, E. and NICOLAU, G., Analele Univ. "C.I.Parhon", St. Naturii, 22, 1959, p.91; Acad. RPR Revue de Chemie, 8, 1963, p.133; Analele Univ. Buc., St. Naturii, Chimie, 13, 1964, p.91; Rev. Roum. Chim., 10, 1965, p.355

17. ANGELESCU, E. and CORNEA, F., Analele Univ. "C.I.Parhon", St. Naturii, Chimie, 26, 1961, p.123; 30, 1961, p.111; 35, 1962, p.121; Analele Univ. Buc. St. Naturii, Chimie, 13, 1964, p.9

18. ANGELESCU, E., DAMIAN, D. and ALBU, C., ASIT Celuloza si Hârtie, 10, 1961, p.381; Bul. Inst. Politehnic Iasi, 11, 1965, p.25

19. ANGELESCU, E. and VASILIU, G., Bul. Stiin. Acad. RPR, Soc. St. Tehnice si Chimice, 3, 1951,p.169

20. ANGELESCU, E., D|MBOVICEANU, A., ROTH, H. and NICOLAU, G., Acad. RPR, Rev. Chim., 3, 1958, p.87; 4, 1959, p.207

21. ANGELESCU, E. and POPESCU, D.M., Kolloid-Z., 51, 1930, p.247, 336

22. ANGELESCU, E. and CIORTAN, V., Kolloid-Z., 82, 1938, p.164, 304; 89, 1939, p.47; 90, 1940, p.302; 94, 1941, p.319; 96, 1941, p.75

23. ANGELESCU, E. and POPESCU, G., Kolloid-Z., 191, 1963, p.130, 136

24. ANGELESCU, E. and DAVIDESCU, Y., Kolloid-Z., 158, 1958, p.135; 162, 1959, p.110

25. ANGELESCU, E. and POPESCU, G., Acad. RPR Studii si Cercetari de Chimie, 7, 1959, p.187; 8, 1960, p.565; 9, 1961, p.593; Kolloid-Z. Z für Polymere, 191, 1963, p.130, 136

26. ANGELESCU, E. and POPESCU, G., IV^{-em} Congrés Intern. De la Détergence, Bruxelles, 1964, II, p.7; Rev. Roum. Chim., 13, 1968, p.1207

27. ANGELESCU, E. and POPESCU, G., Rev. Roum. Chimie, 11, 1966, p.503

28. ANGELESCU, E. and WOINAROSKY, A., Kolloid-Z., 92, 1940, p.99; ANGELESCU, E. and RADU, M., Acad. RPR, Studii si Cercetari de Chimie, 8, 1960, p.399; 9, 1961, p.613; Rev. Roum. Chim., 11, 1966, p.1291; 12, 1967, p.1359; 14, 1968, p.441

29. ANGELESCU, E. and HÖRER, O., Acad. RPR, Studii si Cercetari de Chimie, 8, 1960, p.387; 9, 1961, p.69; 10, 1962, p.49, 151, 337

30. ANGELESCU, E., Acad. RPR, Rev. Chim., 7, 1962, p.21

31. ANGELESCU, E., NICOLAESCU, A. and BARBULESCU, E., Acad. RPR, Studii si Cercetari de Chimie, 11, 1963, p.193; Rev. Roum. Chim., 11, 1966, p.103, 1397