INTRODUCTION

Introductory Remarks

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In 1964, the *Physical Review* published a paper by W. Little, “Possibility of Synthesizing an Organic Superconductor” [1]. This publication became a milestone in the field of superconductivity, and its 50th anniversary was celebrated at a special symposium. The symposium was organized as part of the 4th International Conference on Superconductivity and Magnetism (Antalya, Turkey; Prof. Dr. A. Gencer, conference Chairman). W. Little’s and H. Gutfreund’s contributions to this issue are based on their presentations at this special event.

Why is Little’s paper now recognized as so special? It is natural for a paper to receive high recognition when its

author manages to create a new avenue of research. The paper in question is remarkable even from this point of view, because it formed the basis for not one, but three new directions. Each one of these three occupies an important position in contemporary physics:

1. This publication marked the beginning of the search for high-temperature superconductivity. One’s appreciation of this fact can be enhanced by a historical perspective. Little’s paper was published just several years after the appearance of the BCS theory. One of the first challenges faced by this theory was to understand whether superconductivity is an exclusively low-temperature phenomenon. And in the early 1960s, every scientist working in the field was certain that this was the case. It was “known” that the electron-phonon coupling constant λ cannot exceed the value of $\lambda = 0.5$, and therefore, according to the famous expression for T_c ($T_c \approx \Omega_D \exp(-1/\lambda)$), this meant that the critical temperature is restricted to values about an order of magnitude lower than the Debye temperature. It was proven only later that the restriction $\lambda < 0.5$ does not hold, and today, there are many superconductors around with greater value of the coupling constant, but this was unknown at that time, and the general attitude was that the dream of high-temperature superconductivity was unrealistic.

The atmosphere changed dramatically after the appearance of Little’s paper. As is well known, in his model, electron pairing is enabled not by phonons but by virtual transitions in the second group of electrons, and this key feature results in a drastic increase in T_c . In this way, Little introduced a novel concept—non-

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phonon mechanism of superconductivity—and this set off the search for new materials with high values of T_c .

2. Little focused on one-dimensional, and later quasi-one dimensional, systems, and this led to intensive and multifaceted research into the properties of low-dimensional compounds. Subsequent studies focused on many interesting problems such as phase transitions, fluctuations, and charge density waves.
3. In considering an organic polymer, W. Little predicted the phenomenon of organic superconductivity. Not a single organic superconductor was known then. The first organic superconductor was discovered 16 years later, in 1980.

All points mentioned above have made a great impact on the future development of the field of superconductivity and condensed matter physics in general. The paper attracted great interest and, as described above, gave rise to the search for high- T_c superconductivity. W. Little himself (jointly with H. Gutfreund) published a number of very interesting papers in the field (see, e.g., [2]). This search culminated in the remarkable discovery by G. Bednorz and K. A. Müller of the superconducting state in the copper oxides.

As for the pairing mechanisms, the concept of non-phonon superconducting states caused, e.g., by excitons, magnons, and plasmons has become a common language among scientists involved in the development of the theory of superconductivity.

Analysis of low-dimensional structures also grew into one of the main research frontiers. W. Little himself was actively involved in the creation of the first superconducting polymer, S-N [3]. As for organic superconductivity, the prediction was confirmed by the discovery made by D. Jerome in 1980 [4]. Since then, the field of organic superconductivity has developed greatly, and these materials represent one of the most interesting families of superconductors (see, e.g., [5, 6]).

Both Bill Little and Hanoch Gutfreund are in excellent shape and remain very active. Their articles written for the present issue describe the historical events together with deep insights into present and future developments, and they are fascinating. The readers will certainly enjoy reading them.

References

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