Institute of Experimental Morphology and Anthropology with Museum
Bulgarian Anatomical Society

Acta morphologica et anthropologica, 12
Sofia • 2007

Graphical Method for the Assessment of Eco-sensitivity in the Components of Human Somatotype

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The aim of the present work is to present a new method ensuring possibility for individual assessment of portion between the values of three somatotype components, for evaluation of their eco-sensitivity, for comparison of somatotype data in different studies, and to show the results of its application in sportive-medical practice. The method offered is an original illustrative addition to Heath-Carter's somatotype method. Our method visualizes three-dimensionally the portion between somatotype components' value. The graphic method is elaborated and applied on representative data by M. Toteva in 353 individuals studied longitudinally and 4001 athletes studied transversally. The results from comparative somatotype studies in not engaged in sports children and adolescents, young but already trained beginners and top-class sportsmen in different sport disciplines are shown as an illustration of the graphic method offered. The new method is applicable in morphological control for the assessment of physical development in adolescents and in sportive-medical practice.

Key words. somatotype components, eco-sensitivity, individual assessment, growing up individuals, sportsmen.

Introduction

Somatotype is a complex morphological characterization that is considerably genetically determined [4, 5, 10], while its separate components undergo through different changes during the ontogenetic development [1, 11]. Its eco-sensitivity reflects mainly the type of physical activity in labor, the way of life and sport, the nutritional specificity and nutritional habits, the different diseases, etc. [3, 6, 7, 8, 9].

All purposeful investigations till now show that ages couldn't affect essentially the basic somatotype and their changes remain in the same somatotype zone during whole life. The established changes in the ages express themselves only by moving into neighboring somatotype categories [2, 11]. It depends on the changes of three-somatotype components during different age periods that reflect the age dependent eco-sensitivity of different body tissues and systems.

We didn't found in the special literature purposeful studies giving prominence to the objective evaluation of eco-sensitivity in the separate somatotype components.

The **aim** of the present work is to present a new method ensuring possibility for individual assessment of portion between the values of three somatotype components; for evaluation of their eco-sensitivity; for comparison of somatotype data in different studies; and to show the results of its application in sportive-medical practice.

Material and Methods

The method offered is an original illustrative addition to Heath-Carter's somatotype method [2] by which could be visualized three-dimensionally the values of the three-somatotype components, and comparatively medico-biological information to be gain, as well. It gives possibility for eco-sensitivity of each somatotype component separately to be assessed as connected with age and sex, so dependent to the effect of different factors.

The construction of graphical somatotype models is done on the basis of values (individual or group) for the three-somatotype components. Values are marked on the axes of three-dimensional system at 120 grades centigrade, which system is a base in Heat-Carter's somatotype card, as well. Outwards from center on the left axis are marked the values of endomorph component, on the vertical axis — of mesomorph component, and on the right axis — the ectomorph component. By the connection of points on the three axes is formed a triangle. Fig. 1A illustrates a graphic model of somatopype arbitrarily chosen; being in this case mesomorph-ectomorph (En 2.44 — M 3.81 — Ec 4.01). Comparatively is presented also the Heath-Carter's somato-card of the same somatotype (Fig. 1B). The triangle received by somatotype graphic model gives possibility of portions between the three-somatotype component values to be visualized. This illustrative method gives also possibilities of the results from studies containing data of multiple observations during childhood and adolescence to be compared, a period during which the individual somototype characteristics are more changeable stimulated by the active growth. Such comparisons could be made by/or the selection and health morphological control during training process in sportive-medical practice, as well.

The graphic method is elaborated and applied on representative data elaborated by M. T o t e v a [11] in a longitudinal investigation of not engaged in sports (non-athletic) schoolchildren (7-14 years old), advanced young sportsmen (12-17 years old) who are representatives of 11 sports, and top class sportsmen (mean age: ♀ - 20.2; ♂ - 23.4) representatives of 20 sports. Totally 353 individuals from both sexes are studied longitudinally and 4001 ones — transversally.

Results

As an illustration of the informative possibilities of the graphical method are presented results from comparative somatotype investigations in not engaged in sports children and adolescents (Table 1), beginners but advanced athletes (Table 2) and elite sportsmen engaged in different sports (Table 3).

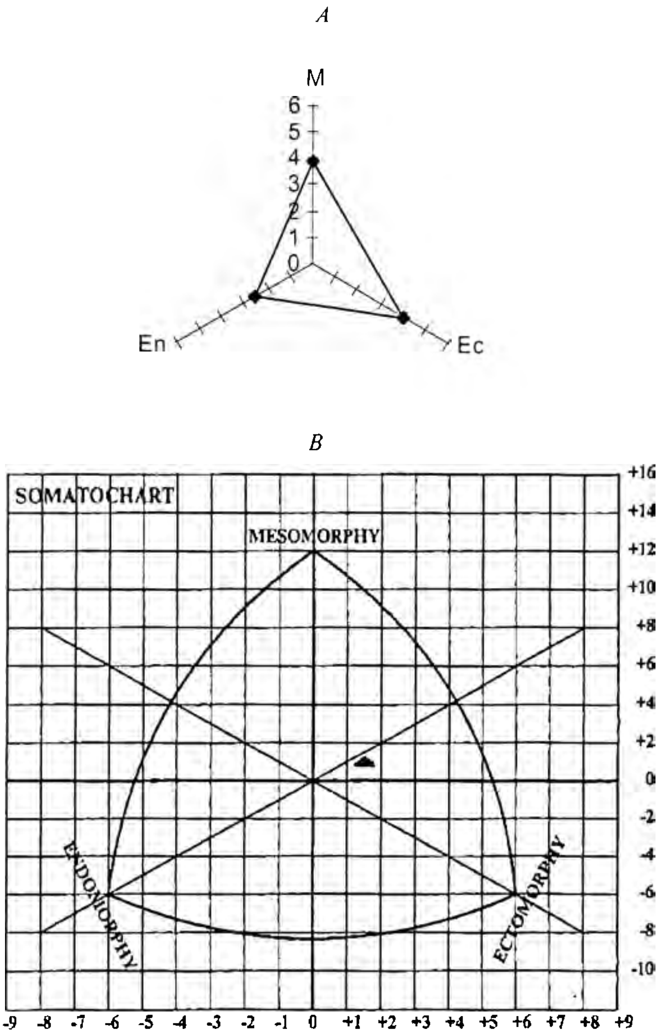

Fig. 1. Illustration of somatotype graphical method according to data about 14 years old not engaged in sports boys Mesomorph-ectomorph somatotype (En 2.44 — M 3.81 — Ec 4.01)
A — Our somatotype graphical model; *B* — Somato-card by Heath-Carter

The longitudinal results of boys and girls not engaged in sports show that for boys aged from 7 till 12 years the mean somatotype is balanced mesomorph, at 13 years — ectomorph-mesomorph, and at 14 years — mesomorph-ectomorph. In girls at 7 years of age the mean somatotype is central, between 8 and 11 years it is balanced mesomorph, and at 14 years — again central.

The construction of our somatotype graphic models gives possibility for the age changes of total somatotype in adolescents established by Heath-Carter's method to be worked out in detail that reflect spatially the quantitative changes in separate components. Illustrated in such manner, the age changes of separate somatotype components could be connected with the quantitative changes in body constitution of the growing up and sexually maturating organism.

T a b l e 1. Somatotype of not engaged in sports 7-14 years old children (longitudinal data)

Sex	Boys										
Age	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**7**	**8**	**9**
En	2.66	2.69	2.88	2.90	2.89	2.90	2.81	2.44	3.04	3.09	3.27
M	4.34	4.43	4.66	4.46	4.53	4.35	4.20	3.81	3.94	4.37	4.36
Ec	3.05	2.91	2.92	2.90	3.21	3.32	3.51	4.01	3.20	2.77	3.12

T a b l e 2. Somatotype of 12-17 years old sportsmen

Sex	Boys							
Sport	*Football players*							
Age	**12**	**13**	**14**	**15**	**16**	**17**	**12**	**13**
En	1.86	1.63	2.08	2.25	2.40	2.30	2.08	2.35
M	4.52	4.66	4.92	5.05	4.85	4.92	4.78	5.26
Ec	4.27	4.00	3.17	3.00	3.20	3.25	2.50	2.16
Sex	**Girls**							
Sport	*Field and track athletes*							
Age	**12**	**13**	**14**	**15**	**16**	**17**	**12**	**13**
En	2.33	2.85	2.93	3.50	3.50	3.94	4.10	3.79
M	3.19	3.59	3.60	3.93	3.31	3.53	3.42	3.32
Ec	4.12	3.97	3.58	3.14	3.44	2.69	3.40	3.61

T a b l e 3. Somatotype of top class sportsmen

Sex	Men			Women	
Sport	*Weght lifters*	*Acrobats*	*Body builders*	*Rhythmic gymnasts*	*Weight lifters*
En	2.90	2.50	1.70	1.53	3.82
M	6.90	5.48	7.15	2.89	6.09
Ec	1.00	2.08	0.94	4.91	0.88

For greater clarity we shall illustrate our results only by the somatotype graphic models of boys and girls at 7 and 14 years of age. In Figures 2A and 2B are presented the somatotype differences in the ages separately for boys and girls, which reflect also the sexual differences in this ages.

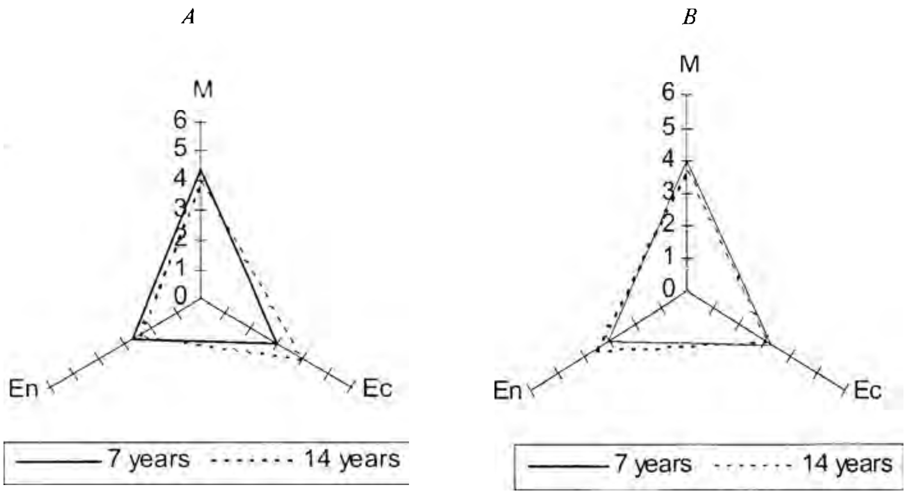

Fig. 2. Somatotype graphical models of not engaged in sports 7-14 years old schoolchildren (longitudinal data)
A — boys; *B* — girls

The analyses of detailed data (Table 1) show that in boys at 7 and 9 years is available slightly increase of endomorphy and mesomorphy, while the ectomorphy decreases. During 9 and 14 years of age, however, the endomorphy and mesomorphy already decrease, if only very few at the expense of the ectomorphy considerable increment.

For girls in the ages, the changes of somatotype components are more slightly expressed. Between 7 and 9 years, the endomorphy and mesomorphy in them slightly increase, and the ectomorphy remains nearly the same. Between 9 and 14 years the values of endomorphy and mesomorphy still increase and the values of ectomophy decrease.

By means of our somatotype graphical models are visualized also the specific sexual differences in somatotype characterization throughout the period 7—14 years. During childhood — 7 years of age, both sexes have relatively equal ectomorphy, the endomorphy being greater for girls and the mesomorphy — for boys. At 9 years (pre-puberty) the sexual differences are similar to those at 7 years. At 14 years of age, however, the sexual differences of somototype components values are underlined better — the endomorphy in girls is already considerably greater, while ectomorphy is considerably smaller compared to boys.

The somatotype characterization being a routine method in sportive-medical practice is very important for the selection of beginners in sport, and for the morphological control during training process, as well. By the application of our somatotype graphic models a precondition for quantity assessment in the differences between somatotype components of beginners and top class sportsmen could be created. In this respect as example we show the results of somatotype graphic models analysis in 12 years old beginners and 17 years old sportsmens who were supposed beening trained at least 5 years the respective sport. Boys are football-players (Fig. 3A) and weight lifters (Fig. 3B); girls are track-and-field athletes — runners (Fig. 4A) and academic rowers (Fig. 4B).

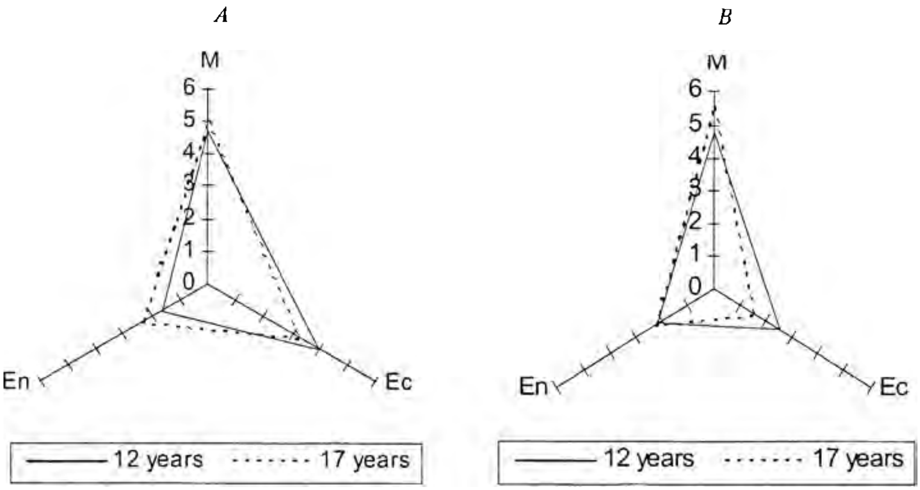

Fig. 3. Somatotype graphical models of 12-17 years old athletes — boys
A — football-players; *B* — weight lifters

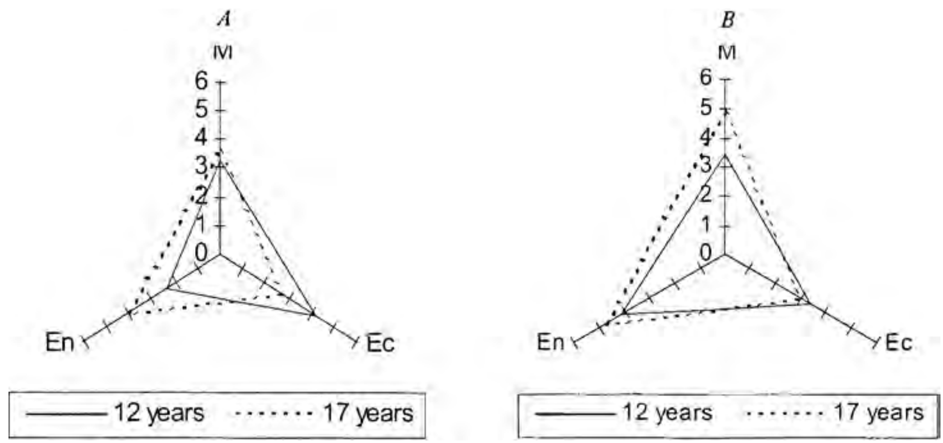

Fig. 4. Somatotype graphical models of 12-17 years old athletes — girls
A — track and field athletes; *B* — academic rowers

Mesomorph-ectomorph is the mean somatotype of the football-players — beginners, and ectomorph-mesomorph of the 17 years old male football-players. Balanced mesomorph is the mean somatotype of the weight lifters — beginners, and endomorph-mesomorph of the 17 years old weight lifters.

In track-and-field female athletes the mean somatotype is mesomorph-ectomorph at 12 years of age, and for the 17 years old ones it is endomorph-mesomorph. In girls academic rowers the mean somatotype is central at 12 years of age, and for the 17 years old ones it is endomorph-mesomorph.

Summarizing the analysis of somatotype graphic models in these sportsmen, it becomes immediately obvious that in boys (football-players and weight lifters) the proportion of ectomorph component inside the complete somatotype decreases in the ages, opposite to those for not engaged in sport boys, by who was established that the proportion of the ectomorph component increases in the ages during the growing up period. For not engaged in sport girls was established that the ectomorphy didn't change in the ages, while for the girl-athletes, as it is for boy-athletes, the ectomorphy decreases in the course of ages.

In male football players, parallel with the decrease of ectomorphy, the values of endomorphy and mesomorphy increase, but in male weight lifters the decrease of ectomorphy is accompanied with mesomorphy increase.

In female track and field athletes the decrease of ectomorphy is accompanied by increase of endomorphy and mesomorphy in the ages, while in female academic rowers the increase of endomorphy is on a small scale and the increase of mesomorphy is considerable.

From sportive-medical point of view it is well known that the athletes' somatotype is of a great importance for their sportive achievements. On the other hand, the somatotype serves as a basis when good evaluation whether someone is appropriate to train the desired by him sport had to be given. This assessment is based on the somatotype model's data of top class sportsmen, by which model on the other hand the morphological control during training process could be supported.

The presentation of the somatotype for top class sportsmen by our somatotype graphic models extends the quantitative base of somatotype assessment used in the sportive-medical practice. It could be realized creating standard somatotype graphic models under sports on the basis of data for respective somatotypes about top class athletes. These models visualize the information about optimal proportion between the values of separate somatotype components in mean somatotype for top class sportsmen engaged in the respective sport, and could be used as evaluation criteria in the sportive-medical practice.

In the present paper we present some exemplary standard somatotype graphic models of top class sportsmen.

The mean somatotype of top class male weight lifters is endomorph-mesomorph (Fig. 5A). Their standard somatotype graphic model shows that the optimal formula concerning the proportion between values of the three components is **3En: 7M: 1Ec.**

The mean somatotype of male acrobats is balanced mesomorph (Fig. 5B), the optimal proportion between each components' value is of the type **2.5En: 5.5M: 2Ec.**

The best illustration about merit and necessity of the presented graphic somatotype model to be applied is the one elaborated for top class male body builders (Fig. 5C).

Their mean somatotype is endomorph-mesomorph. The optimal proportion between values of the three components shows that mesomorphy is 7 times higher than ectomorphy, and nearly 4 times higher than endomorphy — **1.7En: 7M: 1Ec.**

The standard somatotype graphic model of female top class rhythmic gymnasts (Fig. 6A) shows that the mean somatotype is mesomorph-ectomorph, by which ectomorphy dominates nearly twice over mesomorphy, whish on its side dominates nearly two times over endomorphy, i.e. the proportion is of the type **1.5En: 3M: 5Ec.**

In female top class weight lifters (Fig. 6B) the mean somatotype is endomorph-mesomorph. The optimal proportion between its somatotype components is of the type **3.8En: 6M: 0.9Ec.**

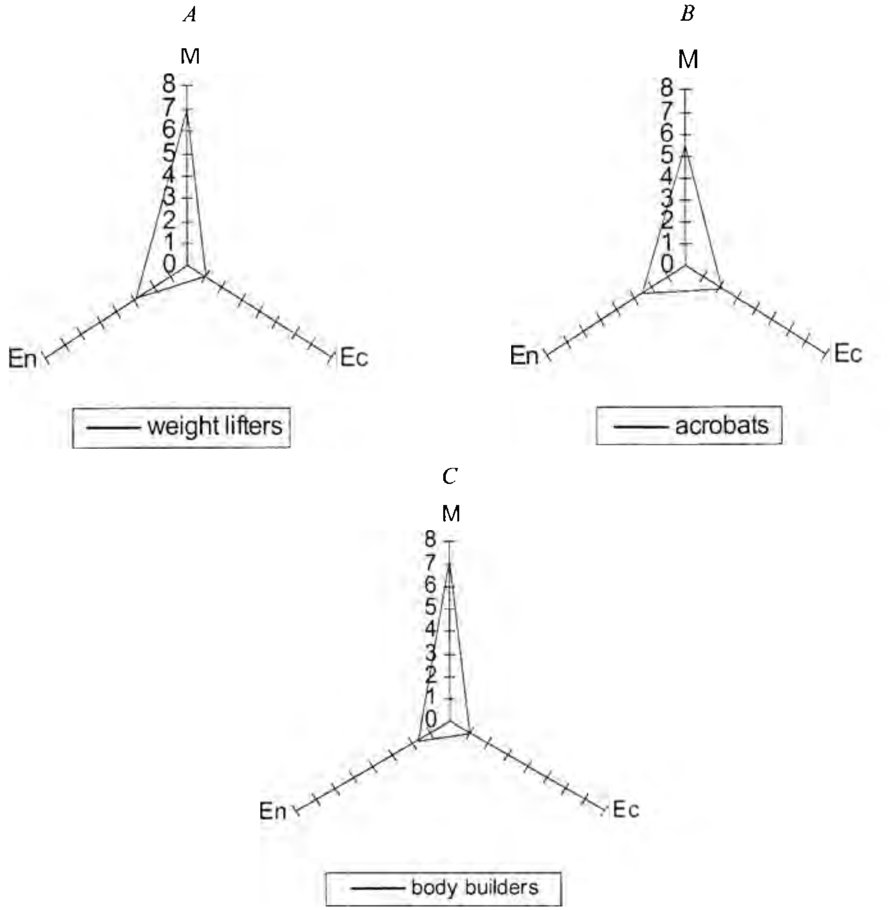

Fig. 5. Standard somatotype graphical models of top class athletes — men
A — weight lifters; *B* — acrobats; *C* — body builders

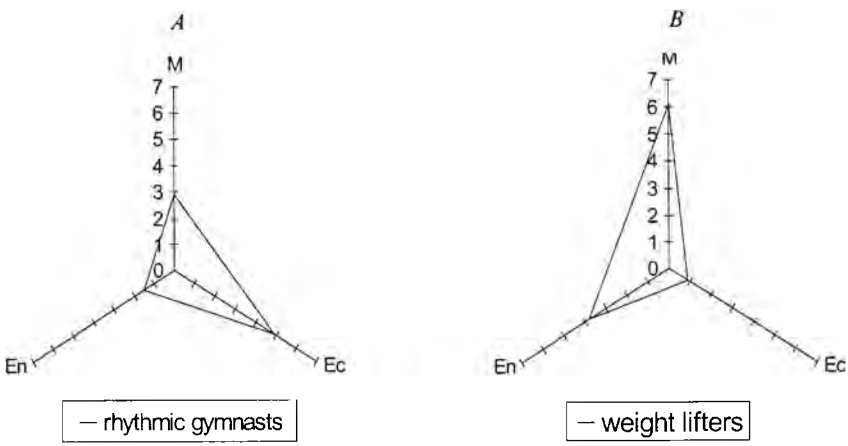

Fig. 6. Standard somatotype graphical models of top class athletes — women
A — rhythmic gymnasts; *B* — weight lifters

By way of example applying our somatotype graphical method is presented the somatotype assessment of beginners weight lifter (En 2.08 — M 4.78—Ec 2.50) and of top class weight lifters (En 2.90 — M 6.90 —Ec 1.00) (Fig. 7). In young weight lifters the endomorph component values are smaller compared to those in top class weight lifters, and the ectomorph component is bigger. The differences are characteristic for the values of both somatotype components. Clearly could be seen the model of body form and structure towards which initially had to be directed the selection of beginners weight lifter, and later their training process. Obviously, the suitable training rules for the selected and turned to this sport individual had to be such that enlarges the mesomorph and lessens the ectomorph component realized by the increment of muscles mass and skeletal massiveness.

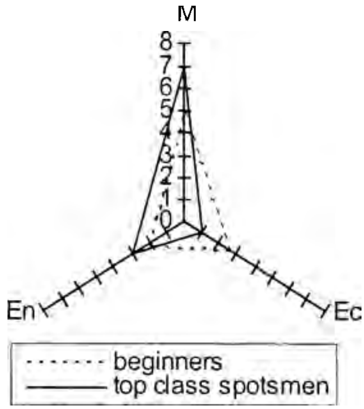

Fig. 7. Application of somatotype graphical models when comparing the somatotype of beginners and top class weight lifters. Somatotype of beginners (2.08 — 4.78 — 2.50);
standard somatotype model (2.90 — 6.90 — 1.00)

Conclusion

The somatotype graphic model and the described results by way of example about its application show that it can be used as in the preventive medical, so in the sportive-medical practice.

Evaluating the physical development of children and adolescents by the somatotype graphical models, the specific interconnected changes of the three-somatotype components could be visualized, which attend the sexual body maturation during this dynamic period on human ontogenesis.

In sportive-medical practice the method ensures objective biometrical data for selection, assessment and control of athletes' morphological constitution.

As an original illustrative addition to Heath-Carter's somatotype method, our graphical method is easy for application and gives direct visual spatial information in self-dependant or comparative investigations.

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