By

PROFESSOR GIORGIO PICCARDI

Director of the Institute of Physical Chemistry
University of Florence
Florence, Italy

The Chemical Basis of Medical Climatology

CHARLES C THOMAS • PUBLISHER
Springfield • Illinois • U.S.A.

Chapter V

BIOLOGICAL TESTS

IF, WHILE *maintaining constant the modalities of the differential experiment*, we substitute the inorganic reaction in an aqueous and colloidal system taken as a test (the hydrolisis of chloride of bismuth) with a biological reaction, we have a *biological test*.

The technique of tests F and D lends itself particularly to our purposes except in special cases because of the necessity of *activating* a part of the material to be tested. The test P technique however, which does not require any interference with the material in question, is highly suitable.

In order to determine whether a biological test P possesses the characteristics necessary to a test, some exploratory experiments were carried out at the Camerata Hospital in Florence by Piccardi and Danti. It is perhaps worthwhile to describe briefly how these experiments were carried out, since they later served as the model for other experiments of the same nature.

On 23 consecutive days, two cc of blood were taken from five healthy persons on an empty stomach. Each sample of blood was subdivided into two series of drops on two paraffined capsules. One of the capsules was covered with a thin copper screen (0.1 mm) horizontally placed above it at a distance of 3 cm. The other capsule was left in the open air near the first. The temperature in which the experiments took place was always constant at 23° C.

Every 30 seconds the drops were touched with a glass rod which had been sharpened to point and a note was made of the time at which a thin thread of fibrin clung to the point of the rod. The coagulation time was counted from the moment at which blood appeared in the cannula to the moment at which the thread of fibrin appeared.

115 experiments were carried out during the month of August 1955. The coagulation time was always greater in the case of the blood placed under the screen at that time. The differences in coagulation time (time under the screen, time away from the screen) fluctuated from a minimum of one minute to a maximum of eight minutes, with a mean value of four minutes. The average coagulation time was 8 minutes for the blood away from the screen, and 12 minutes for the blood under the screen.

Particular note was taken of the fluctuation in the differences of coagulation time because it is precisely this fluctuation of results which guarantees that our system behave effectively in the same manner, as is necessary in a P test (chemical or biological). The differences in coagulation times were correlated with the results of the chemical test P carried on almost simultaneously at the Physical Chemistry Institute of the University. The Institute and the Camerata Hospital are roughly 1.5 km apart. A significant correlation was found to exist between biological test P and chemical test P. It was thus evident that the same spacial phenomena that influenced biological test P influenced chemical test P as well.

After four years, in 1959, experiments on blood coagulation were resumed at the Physiological Institute of the University of Hokkaido at Sapporo (Japan) by Itoh, Tsuijoka and Saito. These authors studied both the blood coagulation of rabbits according to the biological test P technique, and the precipitation of oxychloride of bismuth according to the chemical test P technique. For the two tests they obtained results which fluctuated in the course of time but which could be mutually correlated, precisely as was found in Florence four years earlier. In an article in *The International Journal of Bioclimatology and Biometeorology*, these authors explained the procedure as follows:

"We measured the clotting time of rabbit blood both inside and outside a copper box simultaneously, according to the method of Sahli and Fonio. The ratio of the time *outside/inside* was compared with T% which was determined at the same time. One hundred experiments were carried out during a period from November 1958 to June 1959. Though individual values fluctuated considerably, the mean value of each group showed a consistent ten-

dency: a low ratio of the clotting time when the T% was low, and vice versa. That is, when the rate of colloidal precipitation of bismuth is slower in the copper box than outside of it, the clotting time of blood is also slower in the box. Statistical analysis indicated that the results are highly significant. Thus, the biological P-Test is proven to be correlated with the inorganic P-Test."

As we see, in spite of the different technique (the use of a completely closed copper box instead of a simple horizontal screen placed above the blood samples) and the different method of calculation (ratio of the quotient of clotting times, instead of the difference in clotting), the general results are the same.

This type of study is steadily being developed. For some years, experiments have been under way on the speed of erythrosedimentation, on the flocculation of *Saccharomyces Ellipsoideus* and on its fermenting capabilities, with a view to determining the action of the screen and to study more closely the mechanism of the observed phenomena as related to the results yielded by the chemical tests. Giordano measured erythrosedimentation rates in the open air and in a copper box, using blood samples obtained from several farm animals. All plasmas in spite of their difference showed a significant effect of the copper shield.

The same author, in the spring of 1959, observed several correlations between the behaviour of the fermentation rate of the same stock of *Saccharomyces Ellipsoideus* and Piccardi's Test D.

Giordano and Trenta examined the behaviour of the coagulation of human blood by the relief of its electric resistance, in the open air and under a copper screen. 22 subjects were examined and coagulation was always delayed under the copper screen, during that period of time.

Giordano, Mazza and Maga measured the erythrosedimentation rate according to the differential technique in the open air, in three localities about 70 km apart. The sign of the outside/inside difference was the same.

Mazza studied erythrocyte sedimentation and erythrocyte sedimentation rates by replacing human plasma with liquids of known and constant composition (sodium chloride 0.9%; Macrodex, Sub-

sotan). He observed that a copper screen had a delaying effect during the period in which the tests were being conducted.

Blood clotting is a process which seems subject to the influence of the weather. The blood coagulation rate of rabbits was studied by Caroli and Pichotka. The correspondence with the atmospheric dynamical processes and the clotting seems significant. But Schultz, on the basis of more 120,000 observations on the white blood carried in the years from 1954 to 1959 inclusive, established a sure correlation between the rate of the functional leucopenies, the relative lymphocytoses and the Wolf's number. The correspondence with the solar activity is certain and therefore the correspondence with the inorganic chemical tests is certain also.

We must not forget that Bortels observed an effect of a metallic screen on various micro-biological tests, as was said before.

Vering has demonstrated the action of spacial factors, following the evolution of a single living biological specimen away from and under a copper screen (bacteria cultures that clouded a clear liquid culture or cleared a cloudy liquid culture) by means of photometric methods and automatic recording. The effect of the screen became evident. The variability of the results, accurately analyzed in their relation to operative and experimental conditions, has lead the author to affirm the necessity of reviewing our experimental ideas and the principle of analysis in certain biological, medical and sociological fields.

BIBLIOGRAPHY

1. Assmann, D.: On the question of the spacial influence on the physical-chemical state of blood and practical clinical applications, *Intern. Journal of Bioclimatology and Biometeorology* (in-print).
2. Bortels, H.: Two simple models of meteoro-biological reactions and their relationship to the variation of atmospheric pressure and solar activity. *Arch. fuer Meteor., Geophys. und Bioklim. B 5:* 234, 1954.
3. Bortels, H.: The problem of meteoro-biological relations in the light of microbiological research, *Intern. Journal of Bioclimatology and Biometeorology 3:* part 1, section F, 1959.

4. Caroli, G., and Pichotka, J.: The influence of the weather on the clotting time. ***Naturwiss.***, *39:* 193, 1952.
5. Caroli, G., and Pichotka, J.: Latest research on the relation between clotting and the weather. *Archiv fuer Meteorologie, Geophysik und Bioklimatologie, B 5:* 403, 1954.
6. Giordano, A.: Test P in biology—The differential erythrosedimentation. *Geofisica e Meteorologia, 5:* 51, 1957.
7. Giordano, A.: The differential erythrocyte sedimentation. *Minerva Medica, 49:* 1118, 1958.
8. Giordano, A.: The rate of the erythrosedimentation and the differential erythrosedimentation in domestic animals. *Archivio di Fisiologia, 58:* 270, 1958.
9. Giordano, A.: The decline of the fermentation power of *Saccharomyces Ellipsoideus* and chemical test D. *Geofisica e Meteorologia, 7:* 42, 1959.
10. Giordano, A., Mazza, L., and Maga, M.: Latest contribution the understanding of the differential erythrocyte sedimentation: the environmental effect. *La Settimana Medica, 43:* 65, 1959.
11. Giordano, A., and Trenta, A.: The differential clotting. *La Settimana Medica, 47:* 449, 1959.
12. Itoh, S., Tsujioka, K., and Saito, H.: Blood clotting time under metal cover (biological P-test). *Intern. Journal of Bioclimatology and Biometeorology, 3:* VA, 1959.
13. Mazza, L.: The differential erythrosedimentation—Behaviour of the washed red-corper. *La Settimana Medica, 47:* 84, 1959.
14. Piccardi, G., and Danti, M.: Action of a metallic screen on a biological test. *Wetter und Leben, 7:* Heft 7, 1955.
15. Vering, F.: On the extraterrestrial influences upon microbiological systems—Biological Test P., Symposium International sur les relations entre phénomènes solaires et terrestres en chimie physique et en biologie, Bruxelles 8-10 Octobre 1958, Brussels, Presses Académiques Européennes, p. 177, 1960.