OUTLOOK

The biological part of this book has been written by a biologist who is convinced, from his own experiences as well as from the study of literature, that mitogenetic radiation exists. He has realized that it is difficult to prove it because we are dealing with an extremely weak effect, and with very sensitive detectors. Above all, we are dealing with an entirely new phenomenon, and consequently cannot predict which changes of technique might increase or decrease the effect.

It does not speak well for the present status of science that it has not been possible to settle definitely, in the course of 12 years, the question of the existence of this radiation. The fault lies equally with the two groups of contestants, those for and those against radiation.

The facts are these: Gurwitsch and a number of his pupils and also many other investigators have presented a very large amount of experimental data to show that mitogenetic radiation exists. Many others have repeated these experiments, following directions as exactly as they were given, and obtained no mitogenetic effect. Several of the latter group have claimed therefore that they have disproved biological radiation. Such claim is unscientific as has already been pointed out in the foreword. The only way to disprove any theory is to obtain the same results, and to show that they are due to another cause. Some such attempts have been made (e. g. Moissejewa, Lorenz) but they have not been carried far enough, or have been contradicted by other, more recent investigations. Most of the critics dismiss the question with the simple statement that all so-called mitogenetic effects are within the limits of experimental error.

Let us realize from the beginning that the differences of opinion center around two essentially different points; one is the existence of the biological effect, and the other is its interpretation as an ultraviolet radiation. A different interpretation will not make the effect less important for biology. The effect is the important thing; the explanation is secondary. After all, only the facts remain permanent in science, while the theories come and go.

The difficulties in deciding the existence of the mitogenetic effect are to be sought largely in the sensitivity of the methods. It is evident that this point can be settled only by biological experiments. Physical measurements can tell only whether or not it is caused by radiation, but the absence of radiation does not disprove the biological effect.

Biological measurements are not at all simple. When higher organisms are used as detectors, the controls are not perfect. Several authors have questioned the use of one side of the onion root as control for the other side. It may be that both are affected. This objection may also be made to other tissues, e. g. the cornea. With unicellular organisms, where large numbers are used, the controls are as reliable as they can possibly be in any biological experiment. While it is easy to make yeasts or bacteria grow in the customary culture media, it requires a thorough understanding of their physiology to interprete differences of growth rate, and errors have been made in this respect by those opposing biological radiation as well as by those convinced of it.

The error in biological experiments is not as absolutely fixed as in physical or chemical methods, e. g. in an analysis where it can be stated reliably for all laboratories that the accuracy of the method is 0.005 g. In biology, it depends very much upon the choice of the organism (e. g. the variety of onion), the uniformity of the material, the treatment of the organisms before the beginning of the experiment, the uniformity of environment before and during the experiment, the ability of the experimentor to recognize and avoid disturbing or secondary influences. A fine example is the painstaking work of M. Paul (1933) with onion roots.

As a result of the various factors creeping in, the error of the same method may be widely different in different laboratories or even in the same laboratory with different investigators. This explains the difference of error in the onion root experiments which was 10% with some investigators and 50% with others (see p. 58). When it comes to such delicate instruments as the GEIGER counter, even physical measurements show great differences (see Table 30a p. 92).

The frequently made statement that the biological investigators do not state the error of their methods is not in accordance with the facts. When the error or the reliability of the method is not stated as such, it is usually possible to compute the error from those experiments where no mitogenetic effects were obtained. This has been done by SCHWEMMLE for all earlier onion root experiments (p. 58) and the authors gave some similar calculations for the yeast bud method on p. 71. TUTHILL and RAHN have also published two sets of counts of yeast buds from many different parts of the same culture. GURWITSCH and his associates have stated repeatedly that with the yeast bud method, they consider any increase less than 15% over the control to be experimental error. The reliability of the yeast measurement by volume can be estimated from the data by BILLIG, KANNEGIESSER and SOLOWJEFF. HEINEMANN has stated that in his method of counting yeast with the hemacytometer, the mitogenetic effects were more than 3 times the experimental error. WOLFF and RAS have frequently given all individual counts of bacteria for one experiment (p. 78). Other error limits can be found on pp. 83 (JULIUS), 34 (BARTH) and 168 (BLACHER).

It is somewhat surprising to find that in critical summaries, some weak papers are quoted extensively while some of the best proof in favor of mitogenetic radiation is completely omitted. NAKAIDZUMI and SCHREIBER, working with the yeast bud method, omit the work of SIEBERT who published more detailed experiments than any other investigator in this field. KREUCHEN and BATEMAN also mention neither SIEBERT's papers nor the extensive work of WOLFF and RAS with bacteria which is the best material with this detector. It is only natural that any new development in science will attract speculative minds who generalize from a few experiments and come to conclusions which are not shared by the more conservative workers in this field. Any serious criticism should start with the most reliable and best founded papers.

On the other hand, the critics have good reason to disregard papers which give no precise account of methods or results. Probably the main reason why mitogenetic effects are still doubted has been the recording of results by merely giving the "Induction Effect" without mention of the experimental data from which the effect was computed. The actual number of mitoses in a cornea, the percentage of buds, or the yeast volume measured, tell a good deal about the performance of the experiment. Even the chemist whose methods are really standardized publishes not merely the formula of his new compound, but also the actual analytical data. Since the error in biological experiments varies with the investigator, the publication of the complete records would give the reader a conception of the reliability of any observed effects, even when the standard deviation has not been computed.

Another justifiable argument against the weight of some published papers is the lack of precision in the description of the method. Since the biological detectors do not respond at all times to mitogenetic rays, but only in a definite physiological state, it is of greatest importance to describe all details. Such statements as "8—10 hours at room temperature" are too indefinite; the term "yeast" means very little, and even such terms as "onion root" or "cornea of a frog" should be specified in much more detail since there are many different kinds of onions or frogs, and the roots as well as the number of mitoses in the cornea are affected by the season.

As an example may be mentioned the paper by SALKIND and PONOMAREWA (1934) which might be very important for the physiological explanation of the mitogenetic effect. However, the authors do not mention the age of the yeast culture, nor the medium on which it was grown; they give only the induction effect so that the reader does not know whether the controls had 3% or 25% of buds which would have given a suggestion at least of the condition of the yeast. Therefore, the value of the paper is largely lost.

It might be argued that the burden of the proof lies with the opponents since the mitogeneticists claim to have proved their point, but such an attitude would not be very helpful in solving the real problem. We are dealing with a very complex phenomenon, and both sides should do all they can to bring about a real understanding of the facts. The complexity is greatly increased by the occasional failure of the phenomenon for unknown reasons (p. 93). Errors have been made by the defendants of both sides of the argument, and the authors hope sincerely that by pointing out the mistakes and misunderstandings, a settlement of the question of mitogenetic radiation will be accomplished in a very short time.

SUMMARY OF THE BOOK

Chapter I

Radiation is the transmission of energy through space.

Chapter II

A. There are many physical sources of ultraviolet light.

B. Ultraviolet rays have been proven to be emitted by many well-known chemical and biochemical reactions; their spectra are specific; they may be measured by physical instruments.

C. When irradiated, some solutions produce ultraviolet the wave length of which depends only upon the composition of the solution; it may be shorter than that of the primary source which releases it, and stronger in intensity.

Chapter III

Monochromatic light, less than 2600 Å in wave length, from physical sources has a distinctly stimulating effect upon the growth rate of yeasts and bacteria; so also does ultraviolet radiation from chemical and biochemical reactions.

Chapter IV

A. Many living organisms react to this kind of radiation, and some can be used as biological detectors of such rays:

   a) The oldest detector is the onion root which shows a larger number of mitoses on the irradiated side than on the opposite, shaded side which serves as control;

   b) Yeast cells, under certain conditions, will show an increased percentage of young buds when exposed to mitogenetic radiation;

   c) The growth rate of yeasts or of bacteria is increased when these organisms, at a definite physiological stage of development, are exposed to these rays;

   d) The cornea of mammals and amphibia, the eggs of sea urchins, and tissue cultures have also been used as mitogenetic detectors;

   e) Such radiations affect the metabolism of yeast; respiration is decreased while fermentation is increased;

f) They can produce morphological changes;

g) They disturb the symmetry of LIESEGANG rings, decompose hydrogen peroxide, and increase the rate of flocculation of colloids;

h) Radiant energy from organisms or tissues can be measured by physical instruments;

i) Occasionally, no results can be obtained for several days or weeks; the reason for this is not known.

B. Certain radiations from the human body under abnormal conditions were found to be injurious to yeast.

C. Ultraviolet is emitted by dying organisms.

D. The Beta-radiation from potassium in the cells has decided physiological importance.

E. Infrared rays are rarely if ever emitted, and as rare is their effect upon organisms.

Chapter V

A. Intermittent irradiation increases the intensity of the effect upon biological detectors.

B. Diffuse light is often necessary to induce mitogenetic radiation.

C. Secondary radiation (as explained in II C) is commonly observed in living tissues such as onion roots, muscle, nerve, blood; this facilitates the spreading of mitogenetic stimuli throughout the organism.

D. Too long exposure or too great an intensity is manifested by a decrease in mitoses rather than an increase.

E. The intensity of radiation cannot be measured directly by mitotic increases.

F. When the intensity of radiation is gradually increased from a subliminal value, biological detectors fail to react.

Chapter VI

It is at present impossible to give a precise account of the mechanism by which ultraviolet rays stimulate cell division. Many theories have been advanced.

Chapter VII

Mitogenetic rays play an important role in biology, medicine and agriculture.

A. Some unicellular organisms (bacteria, yeasts, hydra) radiate strongly during their developmental phases, while others (Opalina, Paramecium) do this only in the presence of glucose. Their growth rate is increased by irradiation. This may explain allelocatalysis.

B. Of the higher plants, the roots and most parts of the seedlings are known to emit energy.

C. Dividing eggs of higher animals are good senders as well as good detectors. The medullar plate of embryos shows radiation; during the early stages of frog tadpoles, only the brain radiates strongly.

D. Most tissues of full-grown animals radiate weakly; the working muscle, the cornea, the blood and the nerves being the exceptions. Adult animals and their tissues are not notable as detectors.

E. Blood of all animals radiates strongly; it ceases to do so only during senility, and in the case of a very few diseases.

F. Nerves radiate distinctly, and radiation is transmitted through the nerve at a rate similar to that of nerve stimuli.

G. Morphological changes have been produced by these rays, in yeasts, in bacteria, in sea urchin larvae; they play an important role in the metamorphosis of amphibia; they may be the cause of polyploidy in plants, and of parthenogenesis of frog's eggs.

H. Antagonism between microorganisms has been explained experimentally by radiation.

I. Wounds, while healing, radiate: the healing process can be accelerated by mitogenetic irradiation.

J. The cancerous tissues radiate strongly, while the blood of cancer patients has lost this power. This has been used successfully in the early diagnosis of the disease.

K. Abnormal human radiation which kills microorganisms appears to be linked with the excretion of oxycholesterol.

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AUTHOR INDEX

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Acs, Ladislaus, 1931, Über die mitogenetische Strahlung der Bakterien. Centr. f. Bakt. I Abt. Orig. **120**, 116 . . . . . .75, 78

—, 1932, Weitere Angaben zur mitogenetischen Strahlung der Bakterien. Centr. f. Bakt. I Abt. Orig. **126**, 125 and **200**, 1634, 93, 132

—, 1933, Über echte mitogenetische Depression. Centr. f. Bakt. I Abt. Orig. **127**, 342 172

Anikin, A. W., 1926, Das Nervensystem als Quelle mitogenetischer Strahlung. Roux' Archiv **108**, 609 . . . . 142, 145, 155

— see also L. Gurwitsch.

Arnold see Emerson.

Audubert, R., and van Doormal, 1933, Radiation emission by chemical reactions. Compt. rend. **196**, 1883 and **200**, 1634 . . 34

Barnes, M. N., and Otto Rahn, 1933, Tötung von Hefen durch Strahlungen des menschlichen Körpers. Archiv f. Mikrobiol. **4**, 583 185

— see also Rahn.

Barth, Hans, 1934, Versuche zum physikalischen Nachweis von mitogenetischer Strahlung. Arch. Sciences Biol. (Russ.) **35**, 29 34, 91, 190

Baron, M. A., 1926, Über mitogenetische Strahlung bei Protisten. Roux' Archiv **108**, 617 . . . . 63, 75

—, 1928, Bakterien als Quellen mitogenetischer (ultravioletter) Strahlung. Centr. f. Bakt. II Abt. **73**, 373 . . . . 63, 75

—, 1930, Analyse der mitogenetischen Induktion und deren Bedeutung in der Biologie der Hefe. Planta **10**, 28 . . . . 63, 122, 127, 134

Billig, E., N. Kannegiesser and L. Solowjew, 1932, Die Spektralanalyse der mitogenetischen Strahlung bei Pepsinverdauung und bei der Spaltung von Glycyl-Glycin durch Erepsin. Z. Physiol. Chem. **210**, 220 . . . . 38, 74, 190

Blacher, L. J. and Associates, 1930, Resorptionsprocesse als Quelle der Formbildung. Roux' Archiv 167, 168, 169, 190

I. Blacher and O. G. Holzmann, Die Rolle der mitogenetischen Strahlung in den Prozessen der Metamorphose der schwanzlosen Amphibien. **121**, 48

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BLACHER, L. J., and L. D. LIOSNER, 1932, Mitogenet. Blutstrahlung der Amphibien während der Metamorphose. Roux' Archiv **127,** 364 167

—, A. I. IRICHIMOWITSCH, L. D. LIOSNER and M. A. WORONZOWA, 1932a, Einfluß der mitogenetischen Strahlen auf die Geschwindigkeit der Regeneration. Roux' Archiv **127,** 339 175

—, —, —, —, 1932b, Die mitogenetische Strahlung des Regenerats und des Bluts der Kaulquappen während der Regeneration. Roux' Archiv **127,** 353 174

— and W. N. SAMARAJEW, 1930, Die Organisationszentren von *Hydra fusca* als Quelle mitogenetischer Ausstrahlungen. Biol. Zentr. **50,** 624 133

BÖHMER, K., 1927, Menotoxin und Hefegärung. Deutsch. Z. f. d. ges. gerichtliche Medizin **10,** 448 95

BORODIN, D., 1930, Energy emanation during cell division processes. Plant Physiol. **5,** 119 57

—, 1934, M-rays macro-effect and planimetric drop culture method. I. Internat. Congress of Electro-Radio-Biology, Venice 75

BRAUNSTEIN, A. E. and P. A. HEYFETZ, 1933, Die Glycolyse und die mitogenetische Strahlung des Bluts bei experimentellem Carcinoma. Biochem. Z. **259,** 175 179

— and A. POTOZKY, 1932, Oxydationsreaktionen als Quelle mitogenetischer Strahlung. Biochem. Z. **249,** 270 36

— and B. A. SEVERIN, 1932, Der Zerfall der Kreatinphosphorsäure als mitogenetische Strahlungsquelle. Biochem. Z. **255,** 38 38

BROMLEY, N. W., 1930, Der Einfluß der primären Verheilung der Wunde auf die Entstehung mitogenetischer Ausstrahlungen in ihr. Roux' Archiv **123,** 274 174

— see also BLACHER.

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BROOKS see NELSON.

BRUNETTI, R., and C. MAXIA, 1930, Sulla fotografia a la eccitatione delle radiazione del Gurwitsch. Atti Soc. fra il Cultori delle Science Med. e Nat. Cagliari 2 90

CHARITON, J., G. FRANK and N. KANNEGIESSER, 1930, Über die Wellenlänge und Intensität mitogenetischer Strahlung. Naturwissenschaften 18, 411 . . . . 50, 60

CHRISTIANSEN, W., 1929, Das Menotoxinproblem und die mitogenetischen Strahlen. Ber. d. deutsch. bot. Ges. 47, 357 86, 95, 161, 184, 185

CHRUSTSCHOFF, G. K., 1930, Über die Ursachen des Gewebewachstums in vitro. I. Die Quellen der mitogenetischen Strahlen in Gewebekulturen. Archiv f. exper. Zellforschung 9, 203 83

COBLENTZ, W. W., R. STAIR and J. M. HOGUE, 1931, A balanced thermocouple and filter method for ultraviolet radiometry, with practical applications. Bureau of Standards, Journ. of Research 7, 723 48

DECKER, G. E., 1934, Über die Schärfe mitogenetischer Spektrallinien. Archiv Sciences Biol. (Russ.) 35, 145 37

DIETL see POLANO.

DU BRIDGE see HUGHES.

DOLJANSKI, L., 1932, Das Wachstum der Gewebskulturen in vitro und die GURWITSCH-Strahlung. Roux' Archiv 126, 207. 83

VAN DOORMAL see AUDUBERT.

DUGGAR, B. M. and A. HOLLAENDER, 1934, Irradiation of plant viruses and of microorganisms with monochramatic light. Journ. Bact. 27, 219 48

EMERSON, R., and W. ARNOLD, 1932, A separation of the reactions in photosynthesis by means of intermittent light. Journ. Gen. Physiol. 15, 391. 107

FELDMAN, W. H., 1932, Neoplasms of Domesticated Animals. Philadelphia, Saunders 177

FERGUSON, A. J., 1932, Morphological changes in yeasts induced by biological radiation, Thesis, Cornell University 96, 161

— and OTTO RAHN, 1933, Zum Nachweis mitogenetischer Strahlung durch beschleunigtes Wachstum der Bakterien. Archiv f. Mikrobiol. 4, 574. . . . . 76, 78, 121, 126, 137

FRANK, G., 1929, Das mitogenetische Reizminimum und -maximum und die Wellenlänge mitogenetischer Strahlen. Biol. Zentr. 49, 129 . . . . 35, 39, 60

— and M. KUREPINA, 1930, Die gegenseitige Beeinflussung der Seeigeleier als mitogenetischer Effekt betrachtet. Roux' Archiv 121, 634 138

— and S. RODIONOW, 1932, Physikalische Untersuchung mitogenetischer Strahlung der Muskeln und einiger Oxydationsmodelle. Biochem. Z. 249, 321 . . . . 29, 34, 91, 109

Page

FRANK, G., and S. SALKIND, 1926, [illegible] facteurs
Strahlung im Pflanzenkeimling. [illegible]rmal skin on bacte[illegible]in
— and S. SALKIND, 1927, Mitogenetische [illegible]
Roux' Archiv 110, 626 . . . .
FRANK, M., 1921, Menotoxine in der Frauenmilch. Monatsschr[illegible]
Kinderheilkunde 21, 474 . . . .
FRICKE, HUGO, 1934, The chemical-physical foundation for the biological effects of x-rays. Cold Spring Harbor Symposia II, 241 . . 42
FRIEDRICH see SCHREIBER.
GABOR see REITER.
GATES see RIVERS.
GERLACH, W., 1933, Physikalisches zum Problem mitogenetischen Strahlung. Gesellsch. f. Morphol. u. Physiol. München 42, 1 . 34
GESENIUS, H., 1930a, Über Stoffwechselwirkungen von GURWITSCH-Strahlen. Biochem. Z. 225, 328 84
—, 1930b, Über die GURWITSCH-Strahlung menschlichen Bluts und ihre Bedeutung für die Carcinom-Diagnostik. Biochem. Z. 226, 257 . . . . 85, 153
—, 1932, Blutstrahlung und Carcinom-Diagnostik. Radiobiologia 1 (2), 33 . . . . 85, 179, 180, 181
GILTNER, W., and L. R. HIMMELBERGER, 1912, The use of lactic acid cultures in combating infections of mucous membranes. J. Comp. Pathol. and Ther. 25, 312 177
GOLISCHEWA, K. P., 1933, Die mitogenetische Spektralanalyse der Blutstrahlung am lebenden Tier. Biochem. Z. 260, 52 . . 93, 150
GOLODETZ see UNNA.
GREY, J., and C. OUELLET, 1933, Apparent mitogenetic inactivity of active cells. Proc. Roy. Soc. B 114, 4. 92
GUILLERY, H., 1929, Über Bedingungen des Wachstums auf Grund von Untersuchungen an Gewebskulturen. Virchows Archiv 270, 311 82
GURWITSCH, ALEXANDER, 1922, Über Ursachen der Zellteilung. Roux' Archiv 52, 167 . . . . 59, 119
—, 1923, Die Natur des spezifischen Erregers der Zellteilung. Roux' Archiv 100, 11 . . . . 54, 119
—, 1929a, Die mitogenetische Strahlung aus den Blättern von Sedum. Biol. Zentr. 49, 449 . . . . 141, 173
—, 1929b, Über den derzeitigen Stand des Problems der mitogenetischen Strahlen. Protoplasma 6, 449 . . . . 56, 60
—, 1932, Die mitogenetische Strahlung. Berlin, Springer. 380 pp. 63, 66, 70, 73, 74, 103, 107, 108, 113, 117, 127, 142, 147, 149
—, 1932a, Die mitogenetische Strahlung des markhaltigen Nerven. Pflügers Archiv 231, 234. 155
—, 1934, Der gegenwärtige Stand des mitogenetischen Problems. I. Internat. Congress of Electro-Radio-Biology, Venice . . . 45, 146

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BROOKS see NELSON. L. GURWITSCH, 1925, Über den Ur-
BRUNETTI, R., and C. MAschen Strahlen. Roux' Archiv 105, 470 . 55
delle radiatogenetische Strahlung des Carcinoms. II. Z. f. Scieorschung 29, 220 178

CHARI32a, Die mitogenetische Spektralanalyse: IV. Das mitogenetische Spektrum der Nukleinsäurespaltung. Biochem. Z. 246, 124 38

—, —, 1932b, Die Fortleitung des mitogenetischen Effekts in Lösungen und die Beziehungen zwischen Fermentätigkeit und Strahlung. Biochem. Z. 246, 127 . . . . 43, 109

—, —, 1934, L'analyse mitogenetique spectrale. Vol. IV of Exposés de Physiologie, Paris, Hermann and Cie., 39 pp. 40

GURWITSCH, ANNA, 1931, Die Fortpflanzung des mitogenetischen Erregungszustandes in den Zwiebelwurzeln. Roux' Archiv 124, 357 111

—, 1932, Die mitogenetische Strahlung der optischen Bahn bei adäquater Erregung. Pflügers Archiv 231, 255 . . . . . 157, 159

—, 1934a, L'excitation mitogénétique du système nerveux central. Ann. de Physiol. et Physicochem. biol. 10, 1153 157

—, 1934b, L'excitation mitogénétique du système nerveux pendant l'éclairage monochromatique de l'oeil. Ann. de Physiol. et Physicochem. biol. 10, 1166 158

GURWITSCH, LYDIA, 1931, Die mitogenetische Spektralanalyse: II. Die Spektren des Carcinoms und des Cornealepithels. Biochem. Z. 236, 425 38

— and N. ANIKIN, 1928, Das Cornealepithel als Detektor und Sender mitogenetischer Strahlung. Roux' Archiv 113, 731 84

— and S. SALKIND, 1929, Das mitogenetische Verhalten des Bluts Carcinomatöser. Biochem. Z. 211, 362 . . . . 65, 152, 180

HABERLANDT, G., 1929, Über „mitogenetische Strahlung". Biol. Zentr. 49, 226 173

HALL see JONES.

HAUSSER, K. W., and K. H. KREUCHEN, 1934, Quantenausbeuten bei Lichtzählern. Z. Techn. Physik 15, 20 92

HARVEY see TAYLOR.

HEINEMANN, M., 1932, Cytagenin und mitogenetische Strahlung des Bluts. Klinische Wochenschr. 11, 1375 72, 122, 151, 152, 180, 181, 190

—, 1934, Physico-chemical test for mitogenetic (GURWITSCH) rays. Nature 134, 701 89

—, 1935, Physico-chemical test for mitogenetic (GURWITSCH) rays. Acta Brevia Neerland. 5, 15 89

HENRICI, A. T., 1928, Morphologic Variation and the Rate of Growth of Bacteria. Springfield, C. C. Thomas. 185 pp. 120, 134

HERLANT, M., 1918, Periodische Änderungen der Permeabilität beim befruchteten Seeigelei. Compt. rend. soc. biol. 81, 151 142

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HEYFETZ see BRAUNSTEIN.

HILL, J. H., and E. C. WHITE, 1933, Action of normal skin on bacteria. Archives of Surgery 26, 901 . . . .

HIMMELBERGER see GILTNER.

HOLLAENDER see DUGGAR.

HOLZMANN see BLACHER.

HUGHES, A. L., and L. A. DU BRIDGE, 1932, Photoelectric Phenomena. New York, McGraw-Hill, 531 pp. 20, 26

IRICHIMOWITSCH see BLACHER.

JAEGER, C., 1930, Der Einfluß der Blutstrahlung auf die Gewebskulturen. Z. f. Zellforschung 12, 354 83

JAHN see RICHARDS.

JONES, L. A., and V. C. HALL, 1926, On relation between time and intensity in photographic exposure (IV). J. Opt. Soc. Am. 13, 460 . 24

JULIUS, H. W., 1935, Do mitogenetic rays have any influence on tissue cultures? Acta Brevia Neerland. 5, 51 83

KALENDAROFF, G. S., 1932, Die Spektralanalyse der Strahlung des markhaltigen Nerven im Ruhezustande und bei künstlicher Erregung. Pflügers Archiv 231, 239 . . . . 73, 122, 155

KANNEGIESSER, N., 1931, Die mitogenetische Spektralanalyse I. Biochem. Z. 236, 415. 35

— see also BILLIG and CHARITON.

KARPASS, A. M., and M. N. LANSCHINA, 1929, Mitogenetische Strahlung bei Eiweißverdauung. Biochem. Z. 215, 337 52

KAWAGUCHI, S., 1930, Über den Einfluß der Lichtstrahlen auf den Gesamt-Cholesteringehalt der Haut. Biochem. Z. 221, 232 . . 183

KENDALL see KOSTOFF

KISLIAK-STATKEWISCH, M., 1927, Die mitogenetische Strahlung des Kartoffeleptoms. Roux' Archiv 109, 283. . . . . 141, 145

—, 1929, Die mitogenetische Strahlung des Carcinoms. Z. f. Krebsforschung 29, 214 178

— see also SORIN.

KLEE-RAWIDOWICZ see LASNITZKY.

KLENITZKY, J., 1932, Die mitogenetische Strahlung der weißen Blutelemente. Biochem. Z. 252, 126 151

—, 1934, Le rétablissement de la radiation mitogénétique du sang après l'extirpation d'une tumeur cancéreuse. Arch. Sciences Biol. (Russ.) 35, 218 181

— and E. PROKOFIEWA, 1934, L'analyse spectrale de la radiation mitogénétique de la dèsaggregation des polysaccharides. Arch. Sciences Biol. (Russ.) 35, 211 39

KORÖSI, K. DE, 1934, L'action à distance de la levure sur les sucres. I. Internat. Congress of Electro-Radio-Biology, Venice 45

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BROOKS see NELSON. … L. GURWITSCH, 1925, Über den Ur-
BRUNETTI, R., and C. MA…schen Strahlen. Roux' Archiv **105**, 470 . 55
delle radi…togenetische Strahlung des Carcinoms. II. Z. f. Scie…orschung **29**, 220 178

CHARI…32a, Die mitogenetische Spektralanalyse: IV. Das mitogenetische Spektrum der Nukleinsäurespaltung. Biochem. Z. **246**, 124 38

—, —, 1932b, Die Fortleitung des mitogenetischen Effekts in Lösungen und die Beziehungen zwischen Fermentätigkeit und Strahlung. Biochem. Z. **246**, 127 . . . . 43, 109

—, —, 1934, L'analyse mitogenetique spectrale. Vol. IV of Exposés de Physiologie, Paris, Hermann and Cie., 39 pp. 40

GURWITSCH, ANNA, 1931, Die Fortpflanzung des mitogenetischen Erregungszustandes in den Zwiebelwurzeln. Roux' Archiv **124**, 357 111

—, 1932, Die mitogenetische Strahlung der optischen Bahn bei adäquater Erregung. Pflügers Archiv **231**, 255 . . . . . 157, 159

—, 1934a, L'excitation mitogénétique du système nerveux central. Ann. de Physiol. et Physicochem. biol. **10**, 1153 157

—, 1934b, L'excitation mitogénétique du système nerveux pendant l'éclairage monochromatique de l'oeil. Ann. de Physiol. et Physicochem. biol. **10**, 1166 158

GURWITSCH, LYDIA, 1931, Die mitogenetische Spektralanalyse: II. Die Spektren des Carcinoms und des Cornealepithels. Biochem. Z. **236**, 425 38

— and N. ANIKIN, 1928, Das Cornealepithel als Detektor und Sender mitogenetischer Strahlung. Roux' Archiv **113**, 731 84

— and S. SALKIND, 1929, Das mitogenetische Verhalten des Bluts Carcinomatöser. Biochem. Z. **211**, 362 . . . . 65, 152, 180

HABERLANDT, G., 1929, Über „mitogenetische Strahlung". Biol. Zentr. **49**, 226 173

HALL see JONES.

HAUSSER, K. W., and K. H. KREUCHEN, 1934, Quantenausbeuten bei Lichtzählern. Z. Techn. Physik **15**, 20 92

HARVEY see TAYLOR.

HEINEMANN, M., 1932, Cytagenin und mitogenetische Strahlung des Bluts. Klinische Wochenschr. **11**, 1375 72, 122, 151, 152, 180, 181, 190

—, 1934, Physico-chemical test for mitogenetic (GURWITSCH) rays. Nature **134**, 701 89

—, 1935, Physico-chemical test for mitogenetic (GURWITSCH) rays. Acta Brevia Neerland. **5**, 15 89

HENRICI, A. T., 1928, Morphologic Variation and the Rate of Growth of Bacteria. Springfield, C. C. Thomas. 185 pp. 120, 134

HERLANT, M., 1918, Periodische Änderungen der Permeabilität beim befruchteten Seeigelei. Compt. rend. soc. biol. **81**, 151 142

Page

HEYFETZ see BRAUNSTEIN.

HILL, J. H., and E. C. WHITE, 1933, Action of normal skin on bacteria ... facteurs ... in Archives of Surgery **26**, 901 . . . .

HIMMELBERGER see GILTNER.

HOLLAENDER see DUGGAR.

HOLZMANN see BLACHER.

HUGHES, A. L., and L. A. DU BRIDGE, 1932, Photoelectric Phenomena. New York, McGraw-Hill, 531 pp. 20, 26

IRICHIMOWITSCH see BLACHER.

JAEGER, C., 1930, Der Einfluß der Blutstrahlung auf die Gewebskulturen. Z. f. Zellforschung **12**, 354 83

JAHN see RICHARDS.

JONES, L. A., and V. C. HALL, 1926, On relation between time and intensity in photographic exposure (IV). J. Opt. Soc. Am. **13**, 460 . 24

JULIUS, H. W., 1935, Do mitogenetic rays have any influence on tissue cultures? Acta Brevia Neerland. **5**, 51 83

KALENDAROFF, G. S., 1932, Die Spektralanalyse der Strahlung des markhaltigen Nerven im Ruhezustande und bei künstlicher Erregung. Pflügers Archiv **231**, 239 . . . . 73, 122, 155

KANNEGIESSER, N., 1931, Die mitogenetische Spektralanalyse I. Biochem. Z. **236**, 415. 35

— see also BILLIG and CHARITON.

KARPASS, A. M., and M. N. LANSCHINA, 1929, Mitogenetische Strahlung bei Eiweißverdauung. Biochem. Z. **215**, 337 52

KAWAGUCHI, S., 1930, Über den Einfluß der Lichtstrahlen auf den Gesamt-Cholesteringehalt der Haut. Biochem. Z. **221**, 232 . . 183

KENDALL see KOSTOFF

KISLIAK-STATKEWISCH, M., 1927, Die mitogenetische Strahlung des Kartoffeleptoms. Roux' Archiv **109**, 283 . . . . 141, 145

—, 1929, Die mitogenetische Strahlung des Carcinoms. Z. f. Krebsforschung **29**, 214 178

— see also SORIN.

KLEE-RAWIDOWICZ see LASNITZKY.

KLENITZKY, J., 1932, Die mitogenetische Strahlung der weißen Blutelemente. Biochem. Z. **252**, 126 151

—, 1934, Le rétablissement de la radiation mitogénétique du sang après l'extirpation d'une tumeur cancéreuse. Arch. Sciences Biol. (Russ.) **35**, 218 181

— and E. PROKOFIEWA, 1934, L'analyse spectrale de la radiation mitogénétique de la dèsaggregation des polysaccharides. Arch. Sciences Biol. (Russ.) **35**, 211 39

KORÖSI, K. DE, 1934, L'action à distance de la levure sur les sucres. I. Internat. Congress of Electro-Radio-Biology, Venice 45

Page

BROOKS see NELSON. L. GURWITSCH, 1925, Über den Ur-
BRUNETTI, R., and C. M…schen Strahlen. Roux' Archiv **105**, 470 . 55
delle radi…togenetische Strahlung des Carcinoms. II. Z. f. Scie…orschung **29**, 220 178
CHAR…32a, Die mitogenetische Spektralanalyse: IV. Das mitogenetische Spektrum der Nukleinsäurespaltung. Biochem. Z. **246**, 124 38
—, —, 1932b, Die Fortleitung des mitogenetischen Effekts in Lösungen und die Beziehungen zwischen Fermentätigkeit und Strahlung. Biochem. Z. **246**, 127 . . . . 43, 109
—, —, 1934, L'analyse mitogenetique spectrale. Vol. IV of Exposés de Physiologie, Paris, Hermann and Cie., 39 pp. 40
GURWITSCH, ANNA, 1931, Die Fortpflanzung des mitogenetischen Erregungszustandes in den Zwiebelwurzeln. Roux' Archiv **124**, 357 111
—, 1932, Die mitogenetische Strahlung der optischen Bahn bei adäquater Erregung. Pflügers Archiv **231**, 255 . . . . . 157, 159
—, 1934a, L'excitation mitogénétique du système nerveux central. Ann. de Physiol. et Physicochem. biol. **10**, 1153 157
—, 1934b, L'excitation mitogénétique du système nerveux pendant l'éclairage monochromatique de l'oeil. Ann. de Physiol. et Physicochem. biol. **10**, 1166 158
GURWITSCH, LYDIA, 1931, Die mitogenetische Spektralanalyse: II. Die Spektren des Carcinoms und des Cornealepithels. Biochem. Z. **236**, 425 38
— and N. ANIKIN, 1928, Das Cornealepithel als Detektor und Sender mitogenetischer Strahlung. Roux' Archiv **113**, 731 84
— and S. SALKIND, 1929, Das mitogenetische Verhalten des Bluts Carcinomatöser. Biochem. Z. **211**, 362 . . . . 65, 152, 180
HABERLANDT, G., 1929, Über „mitogenetische Strahlung". Biol. Zentr. **49**, 226 173
HALL see JONES.
HAUSSER, K. W., and K. H. KREUCHEN, 1934, Quantenausbeuten bei Lichtzählern. Z. Techn. Physik **15**, 20 92
HARVEY see TAYLOR.
HEINEMANN, M., 1932, Cytagenin und mitogenetische Strahlung des Bluts. Klinische Wochenschr. **11**, 1375 72, 122, 151, 152, 180, 181, 190
—, 1934, Physico-chemical test for mitogenetic (GURWITSCH) rays. Nature **134**, 701 89
—, 1935, Physico-chemical test for mitogenetic (GURWITSCH) rays. Acta Brevia Neerland. **5**, 15 89
HENRICI, A. T., 1928, Morphologic Variation and the Rate of Growth of Bacteria. Springfield, C. C. Thomas. 185 pp. 120, 134
HERLANT, M., 1918, Periodische Änderungen der Permeabilität beim befruchteten Seeigelei. Compt. rend. soc. biol. **81**, 151 142

Page

HEYFETZ see BRAUNSTEIN.

... facteurs

HILL, J. H., and E. C. WHITE, 1933, Action of normal skin on bacteria in Archives of Surgery **26**, 901 . . . .

HIMMELBERGER see GILTNER.

HOLLAENDER see DUGGAR.

HOLZMANN see BLACHER.

HUGHES, A. L., and L. A. DU BRIDGE, 1932, Photoelectric Phenomena. New York, McGraw-Hill, 531 pp. 20, 26

IRICHIMOWITSCH see BLACHER.

JAEGER, C., 1930, Der Einfluß der Blutstrahlung auf die Gewebskulturen. Z. f. Zellforschung **12**, 354 83

JAHN see RICHARDS.

JONES, L. A., and V. C. HALL, 1926, On relation between time and intensity in photographic exposure (IV). J. Opt. Soc. Am. **13**, 460 . 24

JULIUS, H. W., 1935, Do mitogenetic rays have any influence on tissue cultures? Acta Brevia Neerland. **5**, 51 83

KALENDAROFF, G. S., 1932, Die Spektralanalyse der Strahlung des markhaltigen Nerven im Ruhezustande und bei künstlicher Erregung. Pflügers Archiv **231**, 239 . . . . 73, 122, 155

KANNEGIESSER, N., 1931, Die mitogenetische Spektralanalyse I. Biochem. Z. **236**, 415. 35

— see also BILLIG and CHARITON.

KARPASS, A. M., and M. N. LANSCHINA, 1929, Mitogenetische Strahlung bei Eiweißverdauung. Biochem. Z. **215**, 337 52

KAWAGUCHI, S., 1930, Über den Einfluß der Lichtstrahlen auf den Gesamt-Cholesteringehalt der Haut. Biochem. Z. **221**, 232 . . 183

KENDALL see KOSTOFF

KISLIAK-STATKEWISCH, M., 1927, Die mitogenetische Strahlung des Kartoffeleptoms. Roux' Archiv **109**, 283 . . . . 141, 145

—, 1929, Die mitogenetische Strahlung des Carcinoms. Z. f. Krebsforschung **29**, 214 178

— see also SORIN.

KLEE-RAWIDOWICZ see LASNITZKY.

KLENITZKY, J., 1932, Die mitogenetische Strahlung der weißen Blutelemente. Biochem. Z. **252**, 126 151

—, 1934, Le rétablissement de la radiation mitogénétique du sang après l'extirpation d'une tumeur cancéreuse. Arch. Sciences Biol. (Russ.) **35**, 218 181

— and E. PROKOFIEWA, 1934, L'analyse spectrale de la radiation mitogénétique de la dèsaggregation des polysaccharides. Arch. Sciences Biol. (Russ.) **35**, 211 39

KORÖSI, K. DE, 1934, L'action à distance de la levure sur les sucres. I. Internat. Congress of Electro-Radio-Biology, Venice 45

Page

BROOKS see NELSON. L. GURWITSCH, 1925, Über den Ur-
BRUNETTI, R., and C. M[illegible]schen Strahlen. Roux' Archiv **105**, 470 . 55
delle radi[illegible]togenetische Strahlung des Carcinoms. II. Z. f.
Scie[illegible]rschung **29**, 220 178

CHA[illegible]32a, Die mitogenetische Spektralanalyse: IV. Das mitogenetische Spektrum der Nukleinsäurespaltung. Biochem. Z. **246**, 124 38

—, —, 1932b, Die Fortleitung des mitogenetischen Effekts in Lösungen und die Beziehungen zwischen Fermentätigkeit und Strahlung. Biochem. Z. **246**, 127 . . . . 43, 109

—, —, 1934, L'analyse mitogenetique spectrale. Vol. IV of Exposés de Physiologie, Paris, Hermann and Cie., 39 pp. 40

GURWITSCH, ANNA, 1931, Die Fortpflanzung des mitogenetischen Erregungszustandes in den Zwiebelwurzeln. Roux' Archiv **124**, 357 111

—, 1932, Die mitogenetische Strahlung der optischen Bahn bei adäquater Erregung. Pflügers Archiv **231**, 255 . . . . . 157, 159

—, 1934a, L'excitation mitogénétique du système nerveux central. Ann. de Physiol. et Physicochem. biol. **10**, 1153 157

—, 1934b, L'excitation mitogénétique du système nerveux pendant l'éclairage monochromatique de l'oeil. Ann. de Physiol. et Physicochem. biol. **10**, 1166 158

GURWITSCH, LYDIA, 1931, Die mitogenetische Spektralanalyse: II. Die Spektren des Carcinoms und des Cornealepithels. Biochem. Z. **236**, 425 38

— and N. ANIKIN, 1928, Das Cornealepithel als Detektor und Sender mitogenetischer Strahlung. Roux' Archiv **113**, 731 84

— and S. SALKIND, 1929, Das mitogenetische Verhalten des Bluts Carcinomatöser. Biochem. Z. **211**, 362 . . . . 65, 152, 180

HABERLANDT, G., 1929, Über „mitogenetische Strahlung". Biol. Zentr. **49**, 226 173

HALL see JONES.

HAUSSER, K. W., and K. H. KREUCHEN, 1934, Quantenausbeuten bei Lichtzählern. Z. Techn. Physik **15**, 20 92

HARVEY see TAYLOR.

HEINEMANN, M., 1932, Cytagenin und mitogenetische Strahlung des Bluts. Klinische Wochenschr. **11**, 1375 72, 122, 151, 152, 180, 181, 190

—, 1934, Physico-chemical test for mitogenetic (GURWITSCH) rays. Nature **134**, 701 89

—, 1935, Physico-chemical test for mitogenetic (GURWITSCH) rays. Acta Brevia Neerland. **5**, 15 89

HENRICI, A. T., 1928, Morphologic Variation and the Rate of Growth of Bacteria. Springfield, C. C. Thomas. 185 pp. 120, 134

HERLANT, M., 1918, Periodische Änderungen der Permeabilität beim befruchteten Seeigelei. Compt. rend. soc. biol. **81**, 151 142

Page

HEYFETZ see BRAUNSTEIN.

facteurs

HILL, J. H., and E. C. WHITE, 1933, Action of normal skin on bacte in Archives of Surgery 26, 901 . . . .

HIMMELBERGER see GILTNER.

HOLLAENDER see DUGGAR.

HOLZMANN see BLACHER.

HUGHES, A. L., and L. A. DU BRIDGE, 1932, Photoelectric Phenomena. New York, McGraw-Hill, 531 pp. 20, 26

IRICHIMOWITSCH see BLACHER.

JAEGER, C., 1930, Der Einfluß der Blutstrahlung auf die Gewebskulturen. Z. f. Zellforschung 12, 354 83

JAHN see RICHARDS.

JONES, L. A., and V. C. HALL, 1926, On relation between time and intensity in photographic exposure (IV). J. Opt. Soc. Am. 13, 460 . 24

JULIUS, H. W., 1935, Do mitogenetic rays have any influence on tissue cultures? Acta Brevia Neerland. 5, 51 83

KALENDAROFF, G. S., 1932, Die Spektralanalyse der Strahlung des markhaltigen Nerven im Ruhezustande und bei künstlicher Erregung. Pflügers Archiv 231, 239 . . . . 73, 122, 155

KANNEGIESSER, N., 1931, Die mitogenetische Spektralanalyse I. Biochem. Z. 236, 415. 35

— see also BILLIG and CHARITON.

KARPASS, A. M., and M. N. LANSCHINA, 1929, Mitogenetische Strahlung bei Eiweißverdauung. Biochem. Z. 215, 337 52

KAWAGUCHI, S., 1930, Über den Einfluß der Lichtstrahlen auf den Gesamt-Cholesteringehalt der Haut. Biochem. Z. 221, 232 . . 183

KENDALL see KOSTOFF

KISLIAK-STATKEWISCH, M., 1927, Die mitogenetische Strahlung des Kartoffeleptoms. Roux' Archiv 109, 283 . . . . 141, 145

—, 1929, Die mitogenetische Strahlung des Carcinoms. Z. f. Krebsforschung 29, 214 178

— see also SORIN.

KLEE-RAWIDOWICZ see LASNITZKY.

KLENITZKY, J., 1932, Die mitogenetische Strahlung der weißen Blutelemente. Biochem. Z. 252, 126 151

—, 1934, Le rétablissement de la radiation mitogénétique du sang après l'extirpation d'une tumeur cancéreuse. Arch. Sciences Biol. (Russ.) 35, 218 181

— and E. PROKOFIEWA, 1934, L'analyse spectrale de la radiation mitogénétique de la dèsaggregation des polysaccharides. Arch. Sciences Biol. (Russ.) 35, 211 39

KORÖSI, K. DE, 1934, L'action à distance de la levure sur les sucres. I. Internat. Congress of Electro-Radio-Biology, Venice 45

Page

BROOKS ... d J. KENDALL, 1932, Origin of a tetraploid shoot from
BRUN... e region of a tumor on tomato. Science **76**, 144 169

...CHEN, K. H., 1935, Messung geringer Lichtintensitäten mit Hilfe von Zählrohren. Z. f. Physik **94**, 549 92

— und J. B. BATEMAN, 1934, Physikalische und biologische Untersuchungen über mitogenetische Strahlung. Protoplasma **22**, 243 . . . . 92, 95, 190

— see also HAUSER.

KUREPINA see G. FRANK.

LANSCHINA see KARPASS.

LATMANISOWA, L. W., 1932, Die mitogenetische Sekundärstrahlung des Nerven. Pflügers Archiv **231**, 265 . . . . . 110, 112, 113, 159

—, 1933, Parabiose der Nerven als Folge mitogenetischer Bestrahlung. Naturwissenschaften **21**, 330 159

—, 1934, Sur la parabiose mitogénétique du nerf. Ann. de Physiol. et de Physicochem. Biol. **10**, 141 159

LASNITZKI, A., and E. KLEE-RAWIDOWICZ, 1931, Zur Frage der mitogenetischen Induktion von Warmblüterzellen. Z. f. Krebsforschung **34**, 518 83

LEPESCHKIN, W. W., 1932a, Influence of visible and ultraviolet rays upon the stability of living matter. Am. J. Bot. **19**, 547 . . . 99

—, 1932b, Nekrobiotische Strahlen. Ber. d. deutsch. bot. Ges. **50**, 367 99

—, 1933, Nekrobiotische Strahlen I. Protoplasma **20**, 232 99

LOOS, W., 1930, Untersuchungen über mitogenetische Strahlen. Jahrb. f. wissensch. Botanik **72**, 611 57

LIOSNER see BLACHER.

LORENZ, E., 1933, Investigation of mitogenetic radiation by means of a photoelectric counter tube. U. S. Health Reports **48**, 1311 . 91, 188

—, 1934, Search for mitogenetic radiation by means of the photoelectric method. Journ. General Physiol. **17**, 843 . . . . . 41, 91

LUCAS, G. H. W., 1924, The fractionation of bios. Journ. physical Chem. **28**, 1180 73

LUBIN see MACHT.

MACHT, D. I., and D. S. LUBLIN, 1923/24, A phyto-pharmacological study of menstrual toxin. Journ. of Pharm. and Exp. Ther. **22**, 413 . . . . 95, 184, 185

MAGROU, J., and M. MAGROU, 1927a, Recherches sur les radiations mitogénétiques. Bull. d'Histologie appliqué **4**, 253 . . . . 57, 178

—, —, 1927b, Radiations emises par le *Bacterium tumefaciens*. Rev. path. vég. et ent. agr. **14**, 244 . . . . 57, 178

—, —, 1927c, Rayons mitogénétiques et génése des tumeurs. Compt. rend. **184**, 905 . . . . 171, 178

—, —, 1928, Action à distance du *Bacterium tumefaciens* sur le développement de l'oeuf d'oursin. Compt. rend. **186**, 802 86

Page

MARGOU, J., and M. MARGOU, 1931, Action à distance de facteurs biologiques et chimiques sur le développement de l'oeuf d'oursin (*Paracentrotus lividus* L. K.). Annales des Sciences naturelles: Zoologie **14**, 149 . . . . 86, 165
—, 1932, Action à distance et embryogénèse. Radiobiologia **1** (1), 32 86
— et P. REISS, 1931, Action à distance sur le développement de l'oeuf d'oursin. Essai d'interprétation. Compt. rend. Acad. Paris **193**, 609 86
MALCZYNSKI, S., 1930, Über den Einfluß der einmaligen Bestrahlung mittels Quarzlampe auf den Cholesteringehalt im Blute der nichtkrebsigen und krebskranken Personen. Klinische Wochenschrift **9**, 936 183
MAXIA, C., 1929, Intensificazione delle segmentazione din ova di *Paracentrotus lividus* sotto l'influenza di radiazione mitogenetiche. R. Com. Tallasografico It. Mem. **155** 142
— see also BRUNETTI.
MEES, C. E. K., 1931, Photographic plates for use in spectroscopy and astronomy. Journ. Opt. Soc. Am. **21**, 753 24
MOISSEJEWA, M., 1931, Zur Theorie der mitogenetischen Strahlung.
I. Biochem. Z. **241**, 1.
II. Biochem. Z. **243**, 67.
III. Biochem. Z. **251**, 133 . . . . 62, 188
NAKAIDZUMI, M., und H. SCHREIBER, 1931, Untersuchungen über das mitogenetische Strahlungsproblem II. Biochem. Z. **237**, 358 70, 190
NAKAJIMA see WRIGHT.
NAUMANN, H., 1919, Die Lebenstätigkeit von Sproßpilzen in mineralischen Nährlösungen. Z. f. techn. Biol. **7**, 1 138
NEBLETTE, C. B., 1930, Photography. 2nd ed. New York, Van Nostrand. 198 pp.. 116
NELSON, C. and S. C. BROOKS, 1933, Effect of infra-red light on subsequent fertilisation of the eggs of certain marine invertebrates. Proc. Soc. Exp. Biol. and Med. **30**, 1007 101
NORTH, C. E., 1909, Reports of 300 cases treated with lactic acid bacteria. Medical Record, March 27 177
OKUNEFF, N., 1928, Über einige physico-chemische Erscheinungen während der Regeneration. Biochem. Z. **195**, 421 174
OUELLET see GREY.
PAUL, M., 1933, Zwiebelwurzeln als Detektoren bei Untersuchungen über mitogenetische Strahlung. Roux' Archiv **128**, 108 57, 62, 189
PENFOLD, W. J., 1914, On the nature of bacterial lag. J. Hyg. **14**, 215 134
PFEIFFER, G., 1928—31, Die Cholesterine im Strukturverbande des Protoplasmas. Biochem. Z. **201**, 424; **220**, 53 and 210; **222**, 214; **230**, 439; **231**, 239; **232**, 255; **235**, 97; **236**, 457 186

Page

POLANO, O., and K. DIETL, 1924, Die Einwirkung der Hautabsonderung bei der Menstruierenden auf die Hefegärung. Münchener Med. Wochenschrift **71**, 1385 95

PONOMAREWA, J., 1931, Das detaillierte glykolytische Spektrum. Biochem. Z. **239**, 424 37

POTOZKY, A., 1930, Über Beeinflussung des mitogenetischen Effekts durch sichtbares Licht. Biol. Zentr. **50**, 712 108

—, 1932, Die mitogenetischen Spektra der Oxydationsreaktionen. Biochem. Z. **249**, 282 36

—, S. SALKIND and I. ZOGLINA, 1930, Die mitogenetische Strahlung des Bluts und der Gewebe von Wirbellosen. Biochem. Z. **217**, 178 146

— and I. ZOGLINA, 1928, Über mitogenetische Sekundärstrahlung aus abgeschnittenen Zwiebelwurzeln. Roux' Archiv **114**, 1 . 109

— and I. ZOGLINA, 1929, Mitogenetische Strahlung des Bluts. Biochem. Z. **211**, 352 149

— see also BRAUNSTEIN and SALKIND.

PROKOFIEWA see KLENITZKY.

PROTTI, G., 1930, Impressioni fotografiche di radiazioni ematiche ottenuti attraverso il quarzo. Comm all Sed Scient. Osped. Civile di Venezia 90

—, 1931, L'emoinnesto intramuscolare. Milano, Ulrico Hoepli. 140 pp. 151

—, 1934a, Il fenomeno della emoradiazione applicato alla clinica. Radiobiologia **1** (4), 49 153

—, 1934b, Das Verhalten einiger Tumoren gegenüber dem Saccharomyces cerevisiae. Arch. Sciences Biol. (Russ.) **35**, 255 see also: Effetti citolitici da radiazioni biologiche (citofotolisi). La Ricerca Scientifica **2**, No 99 182

RAHN, OTTO, 1906, Über den Einfluß der Stoffwechselprodukte auf das Wachstum der Bakterien. Centr. f. Bakt. II. Abt. **16**, 418 134

—, 1929, The fermentometer. Journ. Bact. **18**, 199 125

—, 1932, Physiology of Bacteria. Philadelphia, Blakiston. 427 pp. 131

— and M. N. BARNES, 1933, An experimental comparison of different criteria of death in yeast. Journ. Gen. Physiol. **16**, 579 . . . 125

— see also BARNES and FERGUSON and TUTHILL.

RAJEWSKY, B., 1931, in FR. DESSAUER „Zehn Jahre Forschung auf dem physikalisch-medizinischen Grenzgebiet". Leipzig 1931 . 91

—, 1932, Zum Problem der mitogenetischen Strahlung. Z. f. Krebsforschung **35**, 387 91

—, 1934, Über einen empfindlichen Lichtzähler. Physik. Z. **32**, 121 . 92

RAS see WOLFF.

Page

...er, L., and D. Gabor, 1928, Zellteilung und Strahlung. Sonderheft der Wissenschaftl. Veröffentl. aus d. Siemens-Konzern. Berlin, J. Springer . . . 57, 59, 81, 90, 120, 129, 148, 155, 169
... see Margou.

...ards, O. W., and T. L. Jahn, 1933, A photoelectric nephelometer. Journ. Bacteriol. 26, 385 74
... and G. W. Taylor, 1932, „Mitogenetic Rays" — a critique of the yeast detector method. The Biol. Bulletin 63, 113 69
...s, T. M., and F. L. Gates, 1928, Ultraviolet light and vaccine virus. Journ. Exper. Med. 47, 45 48
...tson, T. B., 1924, The nature of the factors which determine the duration of the period of lag in cultures of infusoria. Austral. Journ. Exp. Biol. and Med. Sci. 1, 105 137
Influence of washing etc. Ibid. 1, 151 137
...nsow see G. Frank.
..., A. H., 1933, Heliotropism of cholesterol in relation to skin cancer. Am. Journ. of Cancer 17, 42 182
...34a, Héliotropisme de la cholesterine. I. Internat. Congress of Electro-Radio-Biology, Venice 183
...34b, Action cancérigène des irradiations solaires. I. Internat. Congress of Electro-Radio-Biology, Venice 183
...mann, B., 1928, Untersuchungen über die Theorie der mitogenetischen Strahlen. Roux' Archiv 113, 346 . . . . 57, 58
...er, Max, 1912, Die Ernährungsphysiologie der Hefezelle bei der alkoholischen Gärung. Archiv f. Physiol., Suppl. 1912, p. 1 . 41
...ström, J., 1928, Struktur und Atmung, bei der Entwicklungserregung des Seeigeleies. Acta zoolog. 9, 445 85
..., R., 1933, L'émission de rayons de Gurwitsch par les réactions chimiques entre gaz. Acad. Roy. Belgique, Sciences, 5e série, 19, 535 40
..., H., 1921, Gibt es ein Menstruationsgift? Zentr. f. Gynäkol. 45, 819 95
..., S., 1933, Beiträge zur Analyse der mitogenetischen Effekte, I. Roux' Archiv 128, 378 . . . . 70, 114, 116
...31, Die mitogenetische Strahlung der Larve von *Saccocirrus*. Roux' Archiv 124, 467 144
..., Potozky and I. Zoglina, 1930, Die mitogenetische Beeinflussung der Eier von *Protodrilus* und *Saccocirrus*. Roux' Archiv 121, 630 . . . . 81, 143
... J. Ponomarewa, 1934, Der unmittelbare Einfluß der mitogenetischen Strahlen auf den Verlauf der Zellteilung. Radiologia 1, (4), 3 191

Page

SALKIND see also G. FRANK, L. GURWITSCH and POTOZKY.

SAMARAJEW, W. N., 1932, Die mitogenetische Ausstrahlung bei der Regeneration des Regenwurms. Roux' Archiv **126**, 633 . . . 175

— see also BLACHER.

SCHICK, B., 1920, Das Menstruationsgift. Wiener klin. Wochenschr. **33**, 395 95

SCHOUTEN, S. L., 1933, GURWITSCH-Strahlen und Pilzsporenkeimung. Acta Brevia Neerland. **3**, 68 80

SCHREIBER, H., 1933, Zur Theorie der „mitogenetischen Strahlung". Protoplasma **19**, 1 79

— und W. FRIEDRICH, 1930, Über Nachweis und Intensität der mitogenetischen Strahlung. Biochem. Z. **227**, 386 92

— see also NAKAIDZUMI.

SCHWARZ, 1928, Zur Theorie der mitogenetischen Strahlung. Biol. Zentralbl. **48**, 302 . . . . 57, 58

SCHWEMMLE, J., 1929, Mitogenetische Strahlen. Biol. Zentralbl. **49**, 421 . . . . 57, 190

SCOTT, L. C., 1931, The determination of potassium in cardiac muscle and the presumable influence of the beta-radiations on the rythm. Journ. of Clinical Med. **10**, 745 102

SEVERIN see BRAUNSTEIN.

SEWERTZOWA, L. B., 1929, Über den Einfluß der mitogenetischen Strahlen auf die Vermehrung der Bakterien. Biol. Zentralbl. **49**, 212 . . . . 75, 78

SEYDERHELM, R., 1932, Über einen durch ultraviolette Bestrahlung aktivierbaren, antianämisch wirkenden Stoff im Blut. Klinische Wochenschr. **11**, 628. 151

SIEBERT, W. W., 1928a, Über die mitogenetische Strahlung des Arbeitsmuskels und einiger anderer Gewebe. Biochem. Z. **202**, 115 . . . . 64, 147

—, 1928b, Über die Ursachen der mitogenetischen Strahlung. Biochem. Z. **202**, 133 . . . . 64, 71

—, 1929, Aktionsstrahlung des Muskels und Wachstumswirkung des elektrodynamischen Feldes. Biochem. Z. **215**, 152 71

—, 1930, Die mitogenetische Strahlung des Bluts und des Harns gesunder und kranker Menschen. Biochem. Z. **226**, 253 65, 71, 153

—, 1934, Die „mitogenetische" Strahlung des Bluts in Handb. d. allg. Hämatologie Bd. II, 2, 1339. Berlin, Urban und Schwarzenberg 148

— und H. SEFFERT, 1933, Physikalischer Nachweis der GURWITSCH-Strahlung mit Hilfe eines Differenzverfahrens. Naturwissenschaften **21**, 193 91

—, —, 1934, Zur Frage des physikalischen Nachweises der GURWITSCH-Strahlung. Archiv Sciences Biol. (Russ.) **35**, 177 91

Page

SOLOWJEFF see BILLIG.

SORIN, A. N., and M. KISLIAK-STATKEWITSCH, 1928, Über mitogenetische Induktion in den frühen Entwicklungsstadien des Hühnerembryo. Roux' Archiv **113**, 724 145

STEMPELL, W., 1929, Nachweis der von frischem Zwiebelsohlenbrei ausgesandten Strahlen durch Störung der LIESEGANGschen Ringbildung. Biol. Zentralbl. **49**, 607 88

—, 1931, Das Wasserstoffsuperoxyd als Detektor für Organismenstrahlung und Organismengasung. Protoplasma **12**, 538 . 89, 101

—, 1932, Die unsichtbare Strahlung der Lebewesen. Jena, Gustav Fischer, 88 pp. 59, 89, 93, 164

STRAUSS, W., 1929, Objektive Nephelometrie mittels des MOLLschen Trübungsmessers, demonstriert am Beispiel der Bakterienzählung. Centr. f. Bakt., I. Abt. Orig. **115**, 228 74

SUCHOW, K., and M. SUCHOWA, 1934, Über Coagulationsstrahlung. Archiv Sciences Biol. (Russ.) **35**, 307 100

SUSSMANOWITSCH, H., 1928, Erschöpfung durch mitogenetische Induktion. Roux' Archiv **113**, 753 115

TAYLOR, G. W., and E. N. HARVEY, 1931, The theory of mitogenetic radiation. Biol. Bulletin **61**, 280 . . . . 57, 58

— see also RICHARDS.

TAYLOR, H. S., 1931, A Treatise on Physical Chemistry. New York, D. van Nostrand Co. 46, 90

TUTHILL, J. B., and OTTO RAHN, 1933, Zum Nachweis mitogenetischer Strahlung durch Hefesprossung. Archiv f. Mikrobiol. **4**, 565 66, 120, 121, 190

UNNA, P. G., and L. GOLODETZ, 1909, Die Hautfette. Biochem. Z. **20**, 469 186

WAGNER, N., 1927, Über den von A. GURWITSCH entdeckten spezifischen Erreger der Zellteilung (mitogenetische Strahlen). Biol. Zentralbl. **47**, 670 . . . . 57, 58

WARBURG, OTTO, 1909, Über die Oxydationen im Ei. Z. Physiol. Chem. **60**, 443 142

—, 1919, Über die Geschwindigkeit der photochemischen Kohlensäurezersetzung in lebenden Zellen. Biochem. Z. **100**, 230 105

WASSILIEFF, L. L., 1934, De l'influence du travail cerebral sur la radiation mitogenetique du sang. Arch. Sciences Biol. (Russ.) **35**, 104 150

—, G. M. FRANK und E. E. GOLDENBERG, 1931, Versuche über die mitogenetische Strahlung der Nerven. Biol. Zentralbl. **51**, 225 155

WERNER, S., 1935, Die Entladungsformen im zylindrischen Zählrohr. Z. f. Physik **92**, 705 29

WHITE see HILL.

Page

WILDIERS, E., 1901, Une nouvelle substance indispensible au développement de la lévure. La Cellule **18**, 313 138

WOLFF, L. K., and G. RAS, 1931, Einige Untersuchungen über die mitogenetischen Strahlen von GURWITSCH. Centr. Bakt. I Orig. **123**, 257 . . . . 75, 76, 190

—, —, 1932, Über mitogenetische Strahlen: II. Biochem. Z. **250**, 305 39, 121, 132

—, —, 1933a, Über mitogenetische Strahlen: III. Biochem. Z. **259**, 210 76

—, —, 1933b, Über mitogenetische Strahlen: IV. Über Sekundärstrahlung. Centr. f. Bakt. I Orig. **128**, 306 . . . . 43, 109

—, —, 1933c, V.: Über die Methodik zum Nachweis der GURWITSCH-Strahlen. Centr. f. Bakt. I Orig. **128**, 314 . . . . 80, 93, 116, 146

—, —, 1934a, VI.: Le rayonnement secondaire. K. Akad. Wetensch. Amsterdam **37**, 1 . . . . 45, 109, 113, 114, 123, 190

—, —, 1934b, Effects of mitogenetic rays upon eggs of Drosophila. Nature **133**, 499 . . . . 81, 143

WORONZOWA see BLACHER.

WRIGHT, W. H., and H. NAKAJIMA, 1929, The growing of pure cultures from single cells of non-spore forming bacteria. Journ. Bact. **17**, 10 138

ZIRPOLO, G., Ricerche sulle radiazione mitogenetiche. Boll. Soc. di Naturalisti Napoli **42**, Atti 169 . . . . 81, 142

ZOGLINA see POTOZKY and SALKIND.

ZWAARDEMAKER, H., 1921, Über die Bedeutung der Radioaktivität für das tierische Leben. Ergebnisse d. Physiol. **19**, 326 102

—, 1926/27, Über das Erwachen des durch Kaliumentziehung zur Ruhe gekommenen Herzens durch die Bestrahlung des Radiums. Archiv f. d. ges. Physiol. **215**, 460 102

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