Readings in Cell Physiology

A. Colchicine
B. Mitosis
C. Enzymology (functional) + Protoplasm
D. The Physical Chemistry of Biological Processes
E. Chemistry, miscellany
F. Class reference
G. Bacteriological
H. Genetics

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A. Colchicine

0. Chemistry and Pharmacology
1 Caryoclasis & organismal reaction
2 C-mitosis, etc. Phylogeny
3 physiological correlations
4 Genetic progress with
5 Physical or Chemical theory
6 Other c-agents
7 Misc. and Applications

B. Mitosis

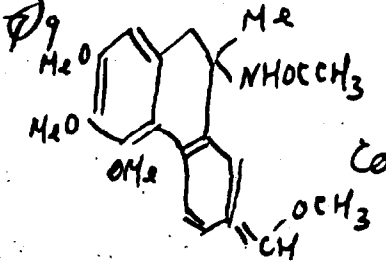
0 Descriptive Morphology
1 Physical measurements (see also 7)
2 Chemical stimuli, specific + [illegible] 7.
3 Sulfhydryl hypothesis; "growth", ... see also 6C
4 Tumors and Cancer conditions; carcinogens
5 Promitosis, Amitosis, etc.
A. NaCN, etc C. Misc
B. other inhibitors D. hormones
6 Toxicology
7. Physical Agents, X Rays, Neutrons, etc
8 Anaerobic conditions
9 Energy metabolism see also 6A, B
10 "Chromosome" metabolism
11 "Genetic Abnormalities"

D. General Biophysics

1. Kinetics & Thermodynamics
2. Diffusion
3. Mathematical
4. Bioelectric
5. Membrane
6. Viscosity, etc. Gel...

Clark + Baines '40 PSEBM 44:340 colch poisoning in dogs treated as for adrenal cortical insufficiency.

Henry '39 The Plant Alkaloids Churchill p574-579



Colchicine after Windaus, etc.

Klein + Pollauf '29 Arch. Bot 2. 78:250

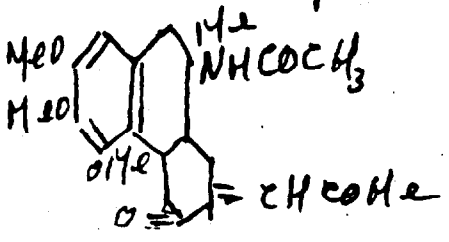
10% silicotungstic ac. + HCl → cryst. balls.

5% $PtCl_4$ + 5% HSCN → crossed needles. $CHCl_3$-NH_4OH extracts. Colch found in various Liliaceae, scilla, Colchicum

Robertson '05 JBC 1:542 Toxicity of colch and salts on Gammarus.

Schiffley + Higgins '40 Pr Mayo Cl 15:536 Colch more toxic in hepatectomies.

Fyfe '39 Imp. Bu Pl Br + Gen.



Chodkowski '37 Pr 28:597 Review of choc.

Chodkowski '39 Arch int Med exp 13:665 Saponin as a coagulant

Delcourt '38 Arch int med exp 13:719 Colch in amphibia high fat deposition in liver. Duesberg theory

Leblond + Sagal '38 CRSB 128:995 Colch provokes the alarm reaction (involution of thymus) hypoplasia of adrenal) as a non-specific poison

Litz '36 Arch int med exp 11:811-901 Duesberg theory: white mouse

75:189

Beams + King '38 BB. Paramecium not affected. Triticum 79:188

——— '40 BB. .0002M, 22 m after fertilization, stops Arbacia

——— '40 JCCP does not affect Paramecium or Amoeba

Boas + Gistle '39 Pr. 33:301 Flax, pea type reaction. Geotropism reversed by eosin counteracted (?) Inhibits eosin fluorescence!!

Comman '41 BB 71:297 Colchicum autumnale affected at 10%, C. byzantium and 5% concentrations.

✓ Dooley '41 T.A.M.S. 60:105 Melanoplus + Gryllus (orthoptera) Giant Sperm, 1-4 fil. Mitochondria short thickened rod. Golgi swollen. ~~Dives~~ Differentiation without division in germ cells!

Bureau + Vilter '39 CRSB 132:553 Ambystoma c-mitosis; no stimulation of CD. in epithelium

Keppel + Dawson '39 BB 76:153 Rana pipiens Various chromosomalities at lower concentrations.

✓ Levan '38 Hereditas 24:471 Allium root tip
✓ " '39 Hereditas 25:9 meiosis
✓ Ludford '36 Arch exp Zf. 18:411 — also similarities with urethane, cacodylate, auramine and colchicine.
✓ O'Mara '39 JH 30:35 Allium smears — good illustration.
Paff '39 Am J Anat 64:331 Chick embryos. <.0045 g. is sublethal dose. Overgrowth, indicating greater cell proliferation under the action of colchicine, invalidating Allen, etc.
Vandendries + Gavaudan '39 CRAS 208:1675 nfx on: Euglena, Chlamydomonas, Saccharomyces, Psilocybe, Stropharia, B. subtilis, etc.
Walker '38 J. Ann. Arb. 19:158 T desc.
✓ X
Walker + Youmans '40 PSEBM 144:271 Bacteria : none.
Wolsky CA 35:1128[8] Rana. 1:5000 severe effect 22 hrs. O.C. not changed.

Bruns + Jackson '37 A.J. Canc 30:504
Sarcoma 180 + mouse liver
7 stages defined + time maxima. ump
Tennant + Liebow '40 Yale J BM 13:39
Tissue culture. type c-mitosis described
compared with Et NC + Pasteur Reaction
Wolcott '41 J H 32:67 Pallavicinia lyelli
(hepaticae) c-mitosis; contraction and
clumping of chromosomes. In space mother cells
independent inhibitions.
Comman, I. Bot. Gaz. 104:50 (1942) Resistance
of Colchicum sp.
Braungart + Ott J. H. 33:163 (1942) Drosophila
mitosis. c- scattered
Sparrow AH Science 96:363 (1942) inhibits
chiasmata in Antirrhinum majus L.
Coatney + Young J. Paras. 25:446 (1937) Plasmodium
relictus (bird malaria). No effect.
Hawkes, MA J Gen 44:11 (1942) Allium
Freud + Uyldert Acta Brevia Neerland
8:16-19 1938 Rats; adrenalectomy
Levine + Gelber Torrey Bull 70:175 (1943)
Metaphase stage: c-root tip onion. Counts;
unilluminating

A2

258–271

Barber & Callan PRSB 131 Colchicine
and cold on newt epidermal mitoses.
See Reprint. Theoretical Generalizations.
Good photos.

Comandon + de Fonbrune CRSB 136: 410–11 '42
1% on Amoebasphaeronucleus.
in medium: no effect; injected at equatorial
late stage: strain of doubled sized which
usually died out.

Boyland + Boyland '37 Bioch. J. 31. Tensensarcoma
Colchicine lowered indophenol reducing power of liver, intestine; not of brain or testis. In graft tumours, hemorrhagy leading to low oxidations. In vitro .03% colch reduced O.C. Colchicine more effective

Brock, Druckrey, Herlsin '39 Arch exp Path Pharm Stongylcentrotus In 500 x dose for CD, no effect on QO_2.

Guinochet '40 CRAS 210: 579 Increases osm pressure in Triticum 7.1 to 11.1 atm. pH vacuole 4.9 – 4.6, pH cytoplasm 5.4-5.2

Patton + Nebel '40 AJB 27: 612 Colch depresses ~~glycolysis~~ at 10^{-4}M, ½ O.C. at 4×10^{-4}; 2×10^{-4} has no r\ effect.
λ proteolysis [dipeptidase: alanyl glycine]

Bagnara, Blakeslee, Avery '40 AJB Datura
following obtained from calli:
$2n-1, 2n+1, 2n+1+1, 4n+1, 4n-6(1),$
$4n-2-2-1-1, 4n-2-1-1-1, 4n-2-1-1,$
$4n-2-2, 4n-1-1-1, 4n-2-1, 4n-1-1,$
$4n-2, 4n-1$
Law, PNAS 24:546 (1938) No effect on
chromosome number in Drosophila

Physical reactions, etc. & Theory

Brams + Krug '38 Biol Bull colch lowers viscosity in Tritecum dividing cells.

Gal '38 BSCB 20 Cacodylate has no effect; colchicine inhibits preparations of lactic and citric dehydrogenase. No effect on succinic, glucose, or glycogen dehydrogenases.

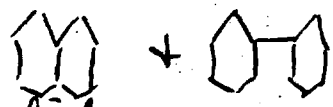
Lein '41 - '42 B.R.C.C.N.Y 4:1 Colchicine lowers the viscosity of U.F. Glycera eggs in hypotonic sea water. Other gels (vitro) not effected.

Smith '41 Obla Ac Sc Pr 21:105 Colch did not inhibit diastase or invertase aside from pH effects. and surface tension

Wada '41 Cyt. 11:93 Viscosity of "attracto-plasm" reduced.

Wilbur '40 PSEBM 45:696 Cent. method Colch reduces mitotic viscosity only, by 60% at first, which later catches up!

Branch '42 Fed. Proc. II (39) Sarcoma 37.
12 similar compounds tested. Mitotic shower (choc!)
~~Cleaetsin '37 J Path Bact 44:469~~ ~~Colch~~

Gavaudan² + Durand '39 CRSB 130:53
 similar effects. few details.

Gavaudan² '39 CRSB. Listed: acenaphthene ethyl magnesium phosphate, $\phi NHCOOEt$, ϕCl_2, heteroauxin, $(CH_3)_3AsONa$, $\phi\phi$, αCl- $\phi\phi$

Gavaudan² '39 CRSB 130:432 comparison with CCl_3CHOH_2 inconclusive.

Sass '37 Phytopath. 27:95 Ethyl magnesium phosphate → polyploidy, multinucleate cells. Spindle + fragments are discernible.

Simonet + Grimochet '39 CRSB 130:1057
Spindle not inhibited although Cl end results are like colchicine. Nuclear fusions.

Bates '39. Nature 143: 643 colchicine polyploids in nature? No.

Levine: '45. Bot. Rev. - Colchicine + X-Ray in New Growths.

Chackin '37 J Path Bact 44:469 Colch can
not be used in treating tumours in ~~vivo~~ vivo
other tissues more affected
Lahr and Riddle AJP 123:614 (1938) Crop
cellulitium in pigeon, endocrine analysis with
colchicine.

Burrows '21 A.J. An. 39:83 "archusia-ergusia relationships. "Cell-environment" complex. no contribution

Chambers '17 J. exp. Zool 23:483 cell astr is a thixotropic gel. Centers + rays are fluid. Division by growth of asters.

Chambers '38 JCCP 12:149 Cell Division in Echinoderm: polar streaming, cortical growth

✓ Cooper '41 PNAS 27:480 Spindle fibers readily seen in living blastomeres of Pediculopsis graminum. No centrioles or asters.

Foot + Strobell '05 A.J. Anat. 4:199 Smears of Allobophora foetida let the spindle flow out as an intact structure

Lamb '08 J Exp Zool 5:27 Hydrodynamic: oscillating centers.

Meek '13, QJMS 58:567 General

Prat + Malkovsky '27 Pr 2:312 :::

Moore '33 J exp 2 10: 230 experiments on Dendraster × Stongylocentrotus crosses indicate that cleavage rate is determined by the egg cytoplasm.

Cannon '23 J. Gen 13: 47 extension of Lamb's hypothesis.

Ris J Exp Zool 90: 267 (1942) Aphid meiosis

Hughes-Schrader & Ris J Exp Zool 87: 429 (1941) Coccid meiosis: diffuse kinetochore.

Stough, JM 52: 535 (1931,) 58: 221 (1935) Modified mitosis

Lucas & Stark JM 52: 91 (1931) UV photos

Hughes-Schrader J Morph 39: 157 (1924) Acroschismus

Metz Am Natural. LXXII (743): 485 1935 Sciara

Metz Bid Bull 644: 333 (1933) Sciara

Scott J Morph 59: 485 1936 Micromalthus

Metz Cytologia 7: 219 (1935) Sciara

Darlington, J. Gen. 37: 341 (1939) Misdivision

Wilson J Morph 53: 443 '32 Phyploidy + mit. patt.

White PRS B 125: 516 '38 Meiosis in Callimantis

Bowen BB 43: 184, 1922 polyploidy in bugs

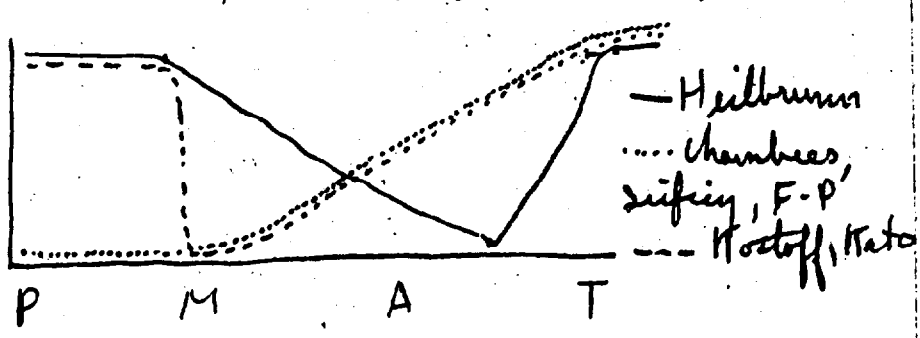
Physical Observations

Barber '39 Chromosoma 1(1):37 rate of chromosome movement measured. .5 - 3μ/minute in different tissue

Dan, Yanagita, and Sugiyama '37 Pr 28:66 movement of kaolin particles followed. Differential stretching of cortex in C.D.

~~Wes '21 CRSB 85:494 Index of refraction peak of 1.405 in late anaphase.~~ v infra

Fry + Parks '34 Pr 21:473 Viscosity Curves in Mitosis, by centrifuge. Summarizes:



Heilbrunn '20 J. Exp. Zool. 30:211 Spindle formation associated with doubling of cytoplasmic viscosity, followed by a drop.

Anesthetics [Et_2O, $CHCl_3$, $AcMe$, paraldehyde, $PrOH$, i $AmOH$, $PrCOOEt$, $EtONO_2$, $MeCN$, $MeNO_2$, $CHCl_3CH(OH)_2$, $\phi NHCOOEt$, $EtNHCOOEt$,] inhibit spindle and gelation

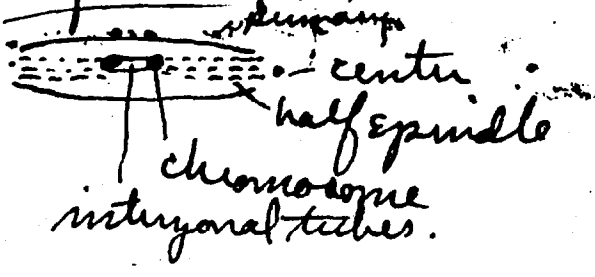
concurrently. Hypotony stops C.D, but is antagonized by ether.

Heilbrunn '21 J. Exp. Zool. 34:417 see above. Cummingia, cytoplasm 2-3 x as viscous at spindle formation.

Luyet '35 PSEBM 33:163 Centrifuging, 30,000G for 1 hour, albumin. chromosomes compspindle is a cone. mitotic cells. pletely displaced. cf. original article.

McClendon '11 Arch Entwm 31:80 .0001 amp + anodic accumulation of basophil and chromosomes on spindle. (.003 amp) but dose. (−) charge on chromatin, as expected from acid character.

Schrader '34 B.B. 67:519 "reality of spindle fibres". Centrifuge Cyclops eggs. bending of longitudinal elements without coagulation. previous components--exist.



Schrader '31 ZwZ 138:386 Protostonia
+synapsis; spindle tubes
Schrader '32 ZwZ 142:520 Hemiptera:
tubular intrazonals + fibers
Schrader '35 Cyt 6:422 Amphiuma
Schrader '36 BB 70:484 Kinetochore
Schrader '40 Biol Symp I:87 Mitosis
Meier Bot Gaz 72:113 (1921) DC on pra cells
Rabinowitz JM 69:1 (1941) Drosophila, temper.
Schrader, J. Morph 68:123 (1941) Anisolabis
Rashevsky. B. Math Biophys 3(1):1 (1941) v. Barber.
elastic contraction.
(Bo) Wilson, E.B. Chondriosomes in Scorpion oGenesis
JM 52: 429 (1931)
Chueney + Klein BB 72:384 (1937) Cataphoresis
Scraia mechr. -+-, n. mem. (+).
Rhoades + Vilhomson PNAS 28:433-36 1942
peculiar mange, preliminary. (Secondary
kinetochores.)
Piza, S. Am. Nat. 77:442-462 (1943) The uselessness of spindle fibers for moving chromosomes.
Vague review

Trurnot '39 Naturw. 27:805 In Psammechinus miliaris thermocouple detects a temperature rise of .02° with peak near the end of mitosis, then a fall sharper than the rise. Triton, parallel results.

Vlès '21 CRSB 85:494 Refractive index, S.U. egg. peak of 1.405 just before end of segmentation.

Beams & King '36 BB 71:188 150000G 10m Ck in Bryo cells. Nucleus stratified: nucleolus, chromatin, enchylema. Spindle is lighter than cytoplasm, may be distorted by centrifuging as by Schader.

Kostoff '30 Pr 11:177 Ant. Nicotiana. On the basis of weak evidence, lowest viscosity is at metaphase.

Laughlin '19 Carn. Inst. Wash.: 265 Statistical Study on the onion. By following the progress of a mitotic wave, the duration of various phases was estimated. This was analyzed against temperature changes at 10°, 20°, 30°. The

early anaphase has a Q_{10} of only .8546
Belar '29 22 Zf bna 10:73 Tradescantia
(hypertony) ascribes great importance to the
Stemmenkoeper in anaphase movements;
directed at the bivitochore; chromosomes
fairly stiff.
Shimamura Cyt 11:186 (1940) Centrif. PMC, etc

B2 Chemical Stimuli

Allee, Finkel, and Gardner '41 Anat Rec 81:s125
dil. Cu^{++} accelerates C.D. in Arbacia

Reid '41 AJB 28:410 Vit. C $\propto \frac{1}{\text{cell size}}$
in cocopea. High C values associated
with nuclear division.

Allee Finkel and Gardner '42 JCCP 26
Cu^{++} More complete account. Crowding
effect. Development accelerated.

Calabrese BA 15:2892 (1939) High K, low Ca
enhance "mitosis rate" in Vicia, Oryza

Hance, RT J Morph 66:409 (1940)
X-Rays fim mitosis in mouse follicle

Marshak '45 AJP 143. Nucleic acid in
regenerating liver.

Ellis '33 JCCP 4:127 See B66
Hammett '29 Ph 7:297, '30 Ph 10:382, '31,
13:261, 331. etc. -SH theory.

Guyer & Claus '39 An Rec 73:17 Viscosity in cancer cells is higher and may be cause of abnormalities

B6a Cyanide, CO, N_2N_3, H_2S.

Andrews, Chase, Delaney '27 Bn Rec 37:161 Arbacia can be fertilized in .006% KCN-seawater but cleavage does not proceed past prophase

Blumenthal '30 Physiol Zool 3:539 Urbacia, KCN (N/1000 - N/10000), eggs proceed at least 10 min before being affected. No direct dependence on oxygen availability presumed.

Ellis '33 see B6b

Eisenberg '36 Trans Phys Inst Leningrad 16:94
EtOH, MeOH, PrOH ∝ temp, M.W.

Ellis '33 JCCP 4:127 Urechis caupo eggs.
F^- M/100, IAcONa M/100, lactate .1% no effect
[-SH!] -SH inhibited somewhat. CN .001M
inhibited, overcome by methylene blue and
dyes $E_0' \leqq .17 \geqq .02$ V ∴ Carbohydrate
metabolism is non-essential.

Zillie '14 JBC 17:121 Various anesthetics
on the S.U. egg after the first cleavage:
CN M/8000, $CCl_3CH(OH)_2$, RNHCOOEt.
Et_2O, $CHCl_3$, paraldehyde, $EtONO_2$, CH_3NO_2, CH_3CN
chloretone are lethal at effective conc. ϕNHAc +
chloralose were ineffective at .5% for 2½ hours. Anesth.
believed based on surface properties.

Rosenfeld '32 Arch exp Zf. 12:570 Et_2O
Chromatin dispersed. Spindle destroyed
to a large extent. Reversal of mitosis.

Shaklevich '35 [BA. '36 12589] 2 ea
H_2 12 hrs. 22-26°C split, pseudotetrads
(c-pairs??) 2n ± 1, Et_2O, same; 40°:

sticky chromosomes, polyploidy.

Rennström '35 BB69 Arbacia: division but abnormal development in .003M IAcOH.

Traub '41 J.H. 30: Sulfanilamide - polynucleate cells, mechanism still to be developed.

Thomas, J.A. CRSB 213:890-2 ('41) Influence of sulfa on sea urchin eggs: 1-5% inhibited development. Not surprised.

Dmitrievy + Schreiber '38 Arch exp Path Pharm 188:208
Caffein particularly inhibits cytokinesis.
Rosenfeld '33 Arch exp Zf. 17 NH_3:
severe clumping of chromosomes. No due
to ^-OH but to NH_3 itself.
Shigenaga '37 Cyt. Fuji: 464 Tradesc. petals
$CHCl_3CH(OH)_2$ - .1% polyploidy, incomplete
walls. small spindle Anaphase abnormality,
.25% nicotine, .25% caffeine No phragmoplast
activity. Walls not formed. $CaCl_2$ had no effect
hydration hypothesis.

Bulser, '39 Z. Zf. M.A., 29:283. Trypaflavin: blocks beginning of new mitoses, does not influence dilration, induced chromatin bridges. Fibrocyte culture + Bulser '33 Cyt. 4:135. Tradescantia: Methylene Blue. long account... may inhibit or arrest prophase. Chromosome bridges. Neutral Red: Sticky chromosomes. Ether antagonized methylene blue

Blumenthal '28 Phys. Zool. 1:269 Arbacia eggs anesthetized in 5% MeCN 1.5% AcOEt 3% iPrOH, 3% n-PrOH, 10% MeOH can be fertilized but do not cleave. CN superimposes an oxygen debt.

Edwards, '36 AJB: 23:483 Neutral salts on Fea. No aberrancies. Lethal effects > $\frac{M}{30}$.

Gosselin '40 CRAS 210:544 Caffeine, Theophylline only wall formation is inhibited.

Haywood + Root '32 JCCP 2:177 CO_2 inhbt. lessened by $NaHCO_3$. Permeability effect Arbacia.

Lehmann + Andrews '34 Pl Phys — Tradesc. No division < 18° > 41° Opt. 28° (69 m.)

CO_2 - C.D. blkd irVsB: ^ dll: Et_2O rVsB
blk ^ 6 m. $CHCl_3$ irVsB 60 sec.
Fluorescein no fk.
Lewis MR '33 Arch Exp Zf 14:464
" " '23 J. Hopk. Hosp Bul 34:373
✓ reversible gelation of spindle at pH = 4.6
'33 Ar Rec 55:A64 hypotony
solated spindle and yielded split chromosomes
as in cancer cells.
'35 Arch exp Zf 17:96 Fluorescent X
sticky chromosomes - terminal adhesions,
non-disjunction, pseudo-amitosis.
Sinota & Yuasa '41 Bot Mag Tokyo
halogens + halides no mitotic data
Zinkernagel '32 Ber Bot 50:134 Allium
Illuminating gas: a few hrs. Disappearance
of spindle Polar chromosome movement
Interfered.

B6d

Drudney '38 Arch exp Path Pharm 188:198
aut. pit. ext., 10^{-4} inhibited Echinus division
other compounds mentioned. No cytology
Eigsti '41 Okla Acad Sci Pr 21:101 hormones + other
compounds affect Tradescantia pollen tube. No details

~~B8~~
B7

Physical Agents

Brams + König '40 JCCP low temperature irreversibly inhibits Ascaris at any stage

Daniel + Chalkley '32 2:311 Temperature characteristic of Arbacia division: CD. 16,500 Pro. 11700 Ana. 20,200. [see Needham '31]

Dragoiu + Ules '21 CRAS 72:1210 Osmotic pressure. Progressively: polynucly, alteration of asters, cytasters, pycnosis, granulation, cytolysis.

Dragoiu '22 CRAS 174:199 Recovery. — 30 atm. Yes. 35 atm. 2 div. 40 atm. No.

Freud, '40 Acta brevia neerland 10:39 3-8°C. cold on newborn rats, 4 hrs. Cells less poisonous. Apnox. Mitosis arrest in normal metaphase

Milovidov '38 Pr 30:427 Desiccation of Vicia roots → micoploidy. May occur in nature thus.

Novarre '23 CRSB 88:191 Rana egg. 0°-4°: achromatic figure unaffected. Telophase

incomplete, some chromosomes and fragments persisting without ~~f~~ going into nucleus.

Temp & Jurd '31 Arch exp Zellf 11:602
5 min. temp., 1-24 hour recovery.
50° 20 m. coagulation; 47°-50° reversible cessation of mitosis 45-46° metaphase block, solation of spindle.

✓ Lewis, MR '33 Arch exp Zf 14:464 Heat vs B: prevented ~~sol~~ gelation of the spindle.

✓ Marsland '38 JCCP 12:57 arbacia, hydrostatic pressure. 450 Atm inhibited cortical division.

Patterson '41, ('42) AJB 28:628 Neutral red sensitizes Hordeum root tips photodynamically 1hr. radiation in 1:75000 N.R ⇒ decrease in CD, death....

✓ Pease '41 ~~J~~ Morph 69:405 ~~sec~~ reprint 1st mitosis Urechis. 3000 lbs/in² destroys spindle completely, granular traces remain until > 6000. Chromosome movement slowed at 2000, retarded at 3000 At > 2000 matrix flows out. At relief, cytasters appear.

Near chromosomes, may form half-spindle which are functional + can pick up chromosomes after metaphase. gel-sol transformation believed important in anaphase movement and the spindle is compared with the cortical gel.

Peraksis + Cotton '39 CRAS 208:1686 Negative evidence for magnetic effect.

Vlès + Dragoiu '21 CRAS 172:1127 Osm. pressure. In the middle of diaster, placed into sea-water + sucrose. 30-60 atm. division rate lowered 60-100 Changes in cell form.

$W = \pi V$. For 1st division 4.09 ergs....

Stilwell An Rec 84:193 (1942) Photodyn. action, neutral red, fibroblasts. Like ether.

Creighton + Evans JM 69:187 (1941) X-Rays on Chorthippus. Giant (1942) of Tids

Carlson, J.G. J Morph 71:449 31r X-Rays on Chortophaga neuroblasts.

Carlson, J.G. CSH Symp 9:104 (1941)

Carlson J Morph 66:11 (1940) 250r

Kamiya Cytologia (Fuj.) 1036 (1937) D.C. + Tradesc.

Stone, Ann. Bot. 47: 815 (1933) X-Rays

Chase Biol Bull 72: 377 (1937) UV Uredies

delays pb formation and cleavage

Helwig J Morph 55: 265 (1933) Xrays Orthopt

B8 Relative oxygen lack

Ambrosson '28 Biol Bull 55:79 clvg in Arbacia is unaffected down to 11 mm. Cleavage ceases at < 4 mm

Andrews, F. '05 An. Bot. 19:521 H_2 reversibly inhibits: 1. Prophase 2. Wall formation. CO_2 inhibited all stages. Mitosis occurred down to 3 mm O_2 in vacuo. Tradescantia.

Brachet '35 Arch. de Biol 45:611 Rana egg Effects only after 15 hours. Then "precytolytic" figures, vitreous nucleus, hyperpigmentation Mitosis can regress, cytasters form, or asters may degenerate to anastral type. Separation of aster from spindle

Laser '33 Bioch Z. 264:72 Chick fibroblasts can survive anoxia. Tumour like metabolism.

✓ Harvey '27 Biol Bull 52:147 Echinus + Stongylocentrotus. H_2, red. Me L Bl. Prophase inhibition.

Havard + Kendal '34 Bioch J 28:1121 Expressed as E_h. tissue culture, division down

to E_h = .02V.

Lyon '02 AJP 7:56 O_2 essential 10-15 mins. after fertilization (nuclear + sperm astr growth?) sensitivity to CN increases as development proceeds.

De Moor '95 Arch de Biol Tradescantia. $\wedge H_2$, wall-formation inhibited. same in CO_2, 7-8 cm O_2,

Nabokich 104 Ber Bot 22:62 Phaseolus, roots cease mitosis in 5 hours of anoxia. Many binucleate

Shoots of Phaseolus, Pisum, Helianthus, 23-40 hours anoxia stops mitosis with few binucleate

Stebbins + Steinetz '39 AJB 26 abst. Hordeum N_2. mitosis stops immediately, some pycnotic survival after 3-4 days in some specimens.

Steinetz. '43, '44 AJB. Effects on mitosis + meiosis. See reprint.

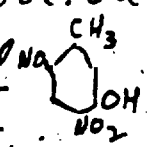
B9. Energy metabolism.

Albaum '42 Zool. Colloquium Col. Un.,
Avena coleoptile, 1st 72 hours. Cytochrome oxidase system, not through C_4. Time coincidence of enzymes and cell division only basis.

Fischer '41 BB 81:282a Benzoate inhibits O.C. 55% before touching C.D. ∴ this inhibitor affects energy-activity metabolism last.

✓Fischer '42 JCCP 19:109 Breaks in O.C. curve, at point of CD. blocks, in urethane concentrations, is evidence for 2 basic systems.

Fischer '42 Fed Proc 29 II. As above. O.C. Fractions

Krahl, Clowes, + Keltch '35 Biol Bull  DNC blocks division in eggs. Sensitivity:
Prophase: Arbacia, Echinarachnius;; All Stages: Asterias; Metaphase: Cummingia, Nereis

Mathews '07 AJP 18:89 Nucleus ulcases oxidase, centers have substrate. O_2 needed for division. Ancient, unfounded. Various inhibitors employed

~~Voegtlin + Chalkley '35 Pr 24. Amoeba.~~
~~H_2S, HCN inhibit prophase; CO is ineffective~~

Lanerat & Willmer '39 J. Exp. Biol 16:232

Glyceraldehyde inhibition of direct glycolysis and growth (T.C. - Chick periosteal fibroblasts)
conclusions: direct (anaerobic glycolysis without phosphorylation, supplies the energy. Evidence is weak and really contradictory. Other aldehydes have same effect on C.D. .02M F, .00005M IAcOH, inhibit growth at proper level.
.002M CN after 10 hours mitosis occurred
95% CO no effect
.001M NaN_3 little inhibition
.01M malonate, fumarate had no effect. After starvation, lactate stimulated mitosis. "Growth dep CO is intimately connected with direct non-phosphorylating glucose breakdown"
Rehland & Ranshorn '38 Planta 28:471 R.Q.s >1.0 in meristems. Fermentation, EtOH, AcOH, and alcohol dehydrogenases & probably aldehyde " are found there. The O.C. is lower than in dividing tissues.

Voegtlin & Challeley '35 Pr 24: Amoeba

H_2S, HCN inhibits mitosis - prophase CO is ineffective except in complete lack of O_2 ∴ mitosis per se is independent of respiration.

Et_2O: irregularities in fission. Na_3AsO_3 does not affect nuclear division but inhibits cell division.

H_2O_2, As_2O_3, MB, $CuCl_2$, $HgCl_2$ have no influence

CO_2 inhibits prophase. HCN as reductants.

The Krahl + Clowes, et al Series on Cell Metabolism + Cell Division

B9a
IT-C

Complete Abstracts K-C papers. J.G.P.

1. Krahl, M.E. + Clowes, GHA. '36 JGP 20:145-
2. " " '36 JGP 20:173
3. " " '40 JGP 23:401
4. " " '40 JGP 23:413
5. " ", Keltch + Nuebeck '41 JGP 24:597
6. Hutchins, Keltch, Krahl, Clowes '42 JGP 25:717
7. Krahl, Jandorf, Clowes '42 JGP 26:233.

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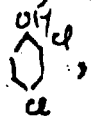
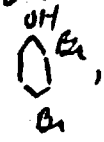
1. @ 8×10⁻⁶M, 4,6 DNoC, e O.C. f Arbacia g. rose ta max 6× Nml U.F., 3× Nml F.)) CD s rVsB blkd @ + bynd e r\ pk, rVsB o r)r" + s.w. (s blk sm. t.b. m) s/V @ e Proph. In y) Cs cp'. dCsd e rdc" tm f cyter aP'l Imltg oxd" Cs e phenols dn mrl: ak y redox s)m. spl" g Nml O-actu". ie rng f cl pt'l. dnp. r n cpB f rVsB O-Red. Vs cp'. -r mpkd + dTmn e rqst cmcl Gp. e rt of OC y Fl: c)' ^ cTl. PCnsgnss sn ^dcd. Fllz" c thple ^.0025M @ .00025M e OC f Fg. s blo Nml @ .0005M e OC f Fg. is 2N + dn Dp blo Nml Utl in VsB DSc"

@ 20°, 25 min. af T Fllz" CD s UmPd UTl OC rC. max @ Cs p' + CrfT dv" s slod or ^hb = Cs blk s rVsB. E peophase ie s/V tm f add lT, e nx dv" s ^hb = RQ rmn. abt. .94

Vs cp'. used Ct r effcV: DNC, mNP, pNP,
DNCml, mDNnfCl, mDNP, hv Cs C\ndg r\ +
CO fk. MB, NeutRed, 10^{-4}M: irreversible blk
e rVsB cbn„ f DNC -(sm clr c)t' or e Dple"
f SSt Im nzm acV Sfc. s sjId e Fe HO- s PbB
efcV e rVsB dv„ blk s ass= -(lmt„ f arbc
mlb; rCr Cn O lk
2  ,  , also used. sm L ccl„.

3. Low O.T. ^hb„ f CO @ .3-.4% @ -C O.C.= 32%
@ 1% e Gt) rTd„ oC. @ Pfz
CO+O_2. 50% ^hb= @ 2.6, rVsB @ .7%O, 32% r\
CO hs no fk o CD o Cr Cn o O.C. z m b vVsB lt
rc„ KCN. 50% ^hb= @ 5×10^{-5}M, rVsB 1.6×10^{-4}%?
@ cplt ^hb„ 34% O.C. e Hl rsdl r\ is
15+%. ans Ctc. ^hb= C.D. l out f PP„
+ O.C., ranging Im 20-106% O.C. @ conc. f
mx blk.
Cyter n fnd ^ g. bt r \nn. Cu psn. ^fcV
Fe found.
4. r\ Iml„ f DNC dCsd z O.T. s lord e dGe
f ^hb„ f C.D. is ^Csd y O.T. s lord. Additive

B9a
15-C

hb. f anoxia + artfcl re Iml b: DNC
IPt : 2 stm. bol stm. Iml = @ [DNC]
oe rsg Cv actvt o.c. hb bgn. @ e
max. Ae [DNC] >, M + M CNs/V r\ s hb =
Malonic ac. fcV

CONCL all xTa OC Im DNC ps. Cu a mll xds stm +
Cu Ip. hb = b: ansTk. /AcOH, malonic, DNT,
N carvacol, @ conc. hbtg Nml r\ 20-40%
CN hbt. m) rsg Pt ~~Pt~~ f DNC Cv; malonic flg.
DNC: ac o one or M fe redox or fsfarltg Ip. ~~Tso~~
TI Im dhDgns + CNs/V xds stm

5 Although cytochrome is absent, an enzyme
cpB f rdcg xdsd cyter e Ps/f PP SSt. x). ie
Arbacia g. e QO_2 fe Fg. cb hb = only 80%
b: CN & 50% b: N_3^- Cs xds s n sgnfc'l:
hb = b DNT, etc. " a Ic fe r\ a P'l: cCnd
-(splg eNg: I dv Ps. mb buyed to e r\
cycle Cu a Cr hvg a sm-t hier pt'l Cu
Cs ~~too~~ C C: e Lb P fe g r\ e xds
Ps' s adqt t C: l fe g. r\

6. Fe 2) 6 hours g. use no ~~Ptn~~ CbhDt,
PbB: use Ptn

7 Cocarboxylase in U.F. g. 2-3r / gm.
DaP. aft Fllz.. Cytolysates attach pyruvate
bT aerobically. F. g. Th sfcV

Oxygen consumption.

Atlas '38 Physiol Zool 11:278 Rana: even respiratory curve from fertilization.

$y = ae^{kt}$

Beatty '41 AJB 28(10): 1s correlation QO_2 with mitotic frequency, growing leaves.

R.Q.'s.

Baldwin '35 J Exp Biol 12:27 R.Q. of developing Limnea eggs about 1.05

Gray '24 B.R. 1:225 In the Echinus egg, London fluctuations in O.C. bear no visible relationship to the cleavage cycle

Chalkley + Voegtlin '40 J Nat Canc Inst 1: 63

Strong oxidation inhibits C.D. The physiological role of -SH is to act with O_2 in regulation of enzyme synthesis, and thereby nuclear growth.

Krugelis '42 JCCP 19: 377 Phosphatase found in mouse testis chromosomes.

Litter, Marble, + Salter '37 Am J Canc 31: 268 The extent of NH_3-sparing by glucose is proportional to the mitotic index in various tissues. May be related to glycolysis and to nuclear metabolism.

Voegtlin '34 Symp. Gen. Biol II: 84 Synthetic proteinase require -SH Glycolysis ... nuclear growth ...

Willmer '42 J. exp. Biol 19: 11 Phosphatase found in Chick endothelium culture chromosm.

Caspersson '38 Chr 1: 147 Tomphocerus: kinase in nucleic acid absorption Spectrum before mid leptotene, constant till diplotene.

Darlington .. '40 J Gen 40: 185 Cold leads to reduction of chromatin in heterochromatic segments of Paeds & Trillium

B11.

Allen, Smith, Gardner '37 A.J.Hn. 61
coleh used to ~~accelerate~~ accentuate Growth effects of thielin

Burström '41 Botan Notiser :310 isolated Triticum roots. C.D. + elongation vary independently ∝ glucose.

Commoner '40 Biol Rev. CN analysis. CN_{SB} Proteins? constant in a wide range of materials, about 5% total. Not sensitive to temperature change RQ .8
CN_{SENS} RQ = 1.0

✓ Commoner + Thimann '41 J. G.P. 24:279
auxin links the C_4 + Growth + respiration only 10% of respiration important.

c1.

Alsup '42 Phys Zool Photodynamic action on Ameba lowers protoplasmic viscosity 30%

Blumenthal '27 Biol Bull 52:313 HCN N/300 - M/2000 increases the rate of water transport in Arbacia in hypotonic sea-water, a time, conc. HCN. KCN causes a decrease in volume, perhaps due to hydrolysis → KOH

Carrizanelli, Rogers, Rapport '42 AJP 135:309 Hypertonicity lowers O.C. brain slices K, Li stimulate O.C., inhibited by Ca^{++}.

✓Caspersson & Schultz '40 PNAS 26:507 Nucleoli and perinuclear cytoplasm have a high concentration of ribose nucleic acid in many materials.

✓Chalkley '37 Pr ~~Pr~~ 28:489 Nitroprusside, -SH test in Amoeba. diffuse stain in intrikinesis. -n nuclear membrane disappears, -SH is discharged into cytoplasm.

~~Ba~~

Ball '42 Wisc. Symp. Resp. Enzymes
CN lowers H cyt. ox. system < cytochrome.
by U.F. Arbacia; cyt. ox. is bound to flavin.
Azide combines with both oxidized and reduced forms of cytochrome oxidase.

Ballentine '40 JCCP 16:39 By centrifuging dehydrogenase systems are considerably localized in granules.

Barnett '42 J. Exp. Biol 19:88 Ascorbic acid is localized in cells as a diffuse Golgi network

Bonner '36 JGP 20:1 Indicat relationship respiration and elongation.

Amano '38 Tr. Jap. Path. Soc 10:549 Uricac found in many nuclei: lymphs

Gomori '41 JCCP 17:71 Histotechnic for ~~acid~~ phosphatase determinations

Hoagland & Brazer '36 Pl Phys. 11:471
Aerobic metabolism is a necessary condition for salt accumulation in roots.

Howard & McClintock '40 JCCP 15:249.

Avena: $AcNH_2$ 2×10^{-3} M Growth inhibited in 24 hours, 50% 9-10 hours 30%. auxin does not appreciably stimulate
✓ Hunter '41 Anat Rec 81:375 CN, F, Hs. although change metabolism of Chick erythrocytes, do not modify semi-permeability
Hutchins, Welch, Krahl, Clowes '42 JGP
carbohydrates, lactic, NO_3 q.v.
Lillie '18 AJP 45:406 Metabolism necessary for semi-permeability of sea-Urchin egg. The fertilized egg is more permeable. CN, anesthesia inhibit permeability increase.
Harvey + Harvey '35 Biol Bull 69:342
The nucleus does not contain most of the cytochrome oxidase activity. also:
Shapiro '35 JCCP 6:101

Havard '35 Br. J. Radiol 8:787 20000R
X-Rays had no significant effect on the activity of lactose, glucose, citric or succinic dehydrogenase preparations, (or on cytochrome oxidase).

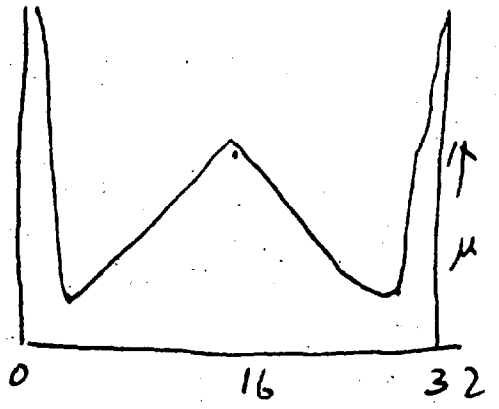
Albaum + Worley, '42 JBC 144:697
Cytochrome + cytochrome oxidase do not appear in the chick embryo before the 5th day, + N_2N_3 does not inhibit before then.

Kitching '39 B.B. 77:339 Anoxia Paramecium
< .28 mm cytolysis eventually. Reversible, not due to CO_2 loss. CN insensitive.

C3

Heilbrunn '24 AJP 68:645 Heat and viscosity

Cunningia:



Northen '40 Ariz Med Soc Tr. 59:279

cyclic or distinct viscosity increase in Spirogyra viscosity with MB, neutral red.

Hoffman '33 Bot Gaz 95: 279 Allium cepa.
The stele arises from 2-4 cells at the distal end. A pericycle is first differentiated, then one large cell enlarges and grows longitudinally yielding the central vessel. Distal to stelar histogen is the meristem of 3-6 x 2-4 cells. Cortical cells develop from periphery root cap from lowest layers.

Rollister '41 Phys. Zool. 14: 268 Mitochondrial ~~alterations~~ orientations. parallel to diffusion pattern assumption of parallel orientation of long protein molecules in hyaloplasm.

2. Medium for pollen-tube cultivation: 2g sucrose
0.5g agar
0.5g gelatin
25cc water

D

(Feb 20 '42)

Johnson, Brown + Maesland '42 Science 95:201.

Brown, Johnson, + Maesland JCCP 20:151 (1942)

Temperature, pressure + luminescence.

Eyring and Magee, JCCP 26: ~~[illegible]~~ 169

absolute r_1, rates and T

Burton JCCP 9,1 (1936) Master Reaction Prim

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et vv

Staughton & Rollefson, JACS 61:2634, 62:2264, and 63:1519 (1941) – Quenching of fluorescence by ions is a bimolecular ionic reaction between quenches and activated dye.

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Basic Structure of Cytoplasm

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✓ Wilson 670-700

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✓ Bowen J Morph 39, 351 (1924) ♂

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Deity okinesis in Rat & Cavy ♂ cytes
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Zoo 117 11/19/42

Phy 59
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11/16/18/42

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Histological classification of tumours

Sarcomatous

Fibroma conn. tissue
Chondroma cartilage
Chordoma chordis dorsalis
Osteoma bone
Myxoma mucous
Lipoma fat
Angioma blood vessel
Lymphoma lymphatic
Sarcoma : cellular tumours of above

Myoma, myosarcoma,
leiomyoma smooth
rhabdomyoma striated

Neuroma -
Neuroma
" ganglionaire
Glioma glia tissue
Neuro-epithelioma ependyma

Endothelioma

Epithelioma : Carcinoma
Papilloma pavement epithelium + vascular supporting tissue
Adenoma benign glandular
Epithelioma atypical arrangement
Carcinoma: glandular, atypical

Consider critically:

1. Spindle gelation + Heilbrunn's determinations of cytoplasmic relations.
2. Viscosity effects of anesthetics
3. Actual viscosity effects of colchicine
4. Actual cytological effects of anesthetics.
5. Generality of colchicine effects + the fundamental identity of mitosis (physiol.)
6. Enzymatic effects of colchicine
7. The gradient + experimental conditions
8. Morphology of mitosis, etc.
9. Protoplasmic structure in relation ...
10. Do energy specifically required for C.D. or the maintenance of spindle
11. The use of inhibitors in enzyme work.

Experimental Plans.

1. The fine cytological effects of CN, NaN_3, Phenylurethane, malonic acid, and colchicine on excised tips + in culture at rigidly controlled experimental conditions.

2. If intrinsic colch gradient is confirmed, effects of variation in temperature, oxygenation, pH and other reagents on it.

3. Micro chemical tests for the distribution of absorbed colchicine.

4. Electrical effects on colchicinized cells

5. High pressure on Allium + partly colchicinized cells, for additive effects. [see Haasland at N.Y.U. see Pease about him.]

6. Antagonism with hypotony.

7. Confirm quenching of eosin fluorescence, and determine possible photodynamic relationships.

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8. If the colchicine gradient is intrinsic, the effects of CN and other metabolic inhibitors as the absorption and accumulation of colchicine by the root cells. [V. Hoagland '36]

9. Look for possibilities in Pollister's ultra-centrifuge

Bacteriology

Virus

1. Chemistry
2. Physics
3. Transplant
4. Mutation
5. Medicine
6. Treatment
7. Pathology
8. Metabolism

Bacteriophage

Northrop

Jordan + Falk

D'Herelle

Bacteriophage

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see for references

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ck chorio-allantois supports many viruses

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N metabolism

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Morgan, S#, S....

Summary of experiment
with Colchicine during 1942

C	N	P	Slide	s.#	# and other data												Colchicine - Results					R.
																			dose			
3	277	C	1	9	1	26	32	10	1	28	29	11	0	33	21	tot	2	87	82	5	27	
3	277	B	1	11	15	31	27	12	10	17	21	13	11	23	30	tot	36	71	78	5	27	
3	282			1	13	33	33	2	12	20	31	3	9	21	27	tot	34	74	101	5	25½	
3	283	A	2	4	24	29	54	25	22	28	41	26	20	30	41	tot	66	87	136	5	24	
3	283	B	1	3	58	10	38	14	38	7	44	15	45	8	48	tot	141	25	130	5	24	
3	280	B	8		7	53	15	9	4	53	12	10	5	57	24	+	16	163	51	6	8	
3	285		2	0	0	27	32	21	0	45	50	22	0	60	71	0	0	122	153	6	½	
3	328	A	2	5	1	29	32	26	3	28	21	27	5	21	24	+	9	78	77	6	2	
3	329	A	2	5	2	37	42	26	1	30	47	27	4	30	50	+	7	97	134	6	2	
3	330	A	2	1	6	24	19	22	9	29	43	23	9	41	29	+	24	114	91	6	3	
3	330	B	1	6	5	25	22	17	11	18	30	18	10	18	30	+	26	61	82	6	3	
	331	B	1	3	26	11	24	14	16	11	22	15	19	11	16	+	61	33	62	6	4½	
	331	C	2	6	28	6	21	27	35	12	22	28	15	8	12	+	78	28	55	6	4½	
	332			8	73	4	39	9	66	3	34	10	78	3	39	+	217	10	112	6	8	
	333	A	1	4	34	6	10	15	58	4	10	16	62	8	11	+	154	18	31	6	12	
	333	B	3	7	76	11	44	38	69	5	34	39	61	11	36	+	206	27	114	6	12	
	334	A	1	4	21	20	32	15	13	21	12	16	8	10	10	+	42	81	54	6	22	
	334	B	1	3	59	7	27	14	69	15	28	15	54	7	32	+	182	29	87	6	22	
	335	A	1	8	5	14	21	9	2	16	15	20	7	23	31	+	14	53	67	6	46	
	335	B	1	5	17	8	17	16	13	9	19	17	13	8	16	+	43	25	52	6	46	
	262	2	1		87	11	[illegible]	2	109	13	[illegible]	3	87	6	38	1:3	68	15	[illegible]	5	+	
	262	4	2		64	7	[illegible]	1	105	3	[illegible]	3:1	64	17	[illegible]	t/2	292	36	167	5	+	
	351	A	1	6	0	24	51	17	0	25	32	18	0	28	35	+	0	77	114	6	0	
	351	B	1		0	62	81	2	0	66	73	3	0	82	87	+	0	190	241	6	0	
	353	A			1	27	19		-	22	18		-	29	23		1	78	60	6	2	
{	353	B	2		0	15	29	3	0	27	30	39	0	16	17	40	0	26	21	6	2	
{			4		0	23	17									3½	0	64	114	6	[illegible]	
{	355	A	1		13	3	20	2	9	4	18	3	9	8	13	4	19	5	21	6	4	
{			5		12	4	18									3½	37	14	60	6	4	
{	355	B	6		12	7	20	7	10	6	14	8	5	7	23	9	4	8	18	6	4	
{			10		8	6	20									3½	23	20	57	6	4	
	361	A	1	0	18	3	18	11	17	0	31	12	23	0	19	+	58	3	68	6	7	
	363	A	A		11	10	5	8	13	0	19	c	11	0	7	+	35	1	[illegible]	6	8	
	365	A	3	[illegible]	40	1	25	33	54	0	36	34	42	0	18	+	136	1	79	6	9	
	365	B	1	2	44	0	18	13	52	0	19	15	8	0	26	+	176	2	63	6	9	
	367	A	2		69	9	29	1	62	3	14					3½	180	18	63	6	10	
	367	B	1	5	24	1	8	11	19	0	8					3½	[illegible]	2	24	6	10	

Summary of exper. results: Colchicine: Spring 1942.

aw Data summarized:

371	B	13	4	22	12								+	6	12	12	66	36
371	C												+	6	12			
373	–		62	0	31									6	13	186	0	93
369	A		48	0	15									6	11	144	0	45
369	B		34	2	18									6	11	117	6	54
371	E		9	0	9									6	12	27	0	27
362	A	A	20	16	23	B	8	16	22	C	18	7	19	+	46	39	64	5	8
366	A		16	8	27									+	48	24	81	5	10
368	A		25	9	24									+	75	27	72	5	11
374			6	26	22									+	18	81	66	5	25
370			60	5	41									+	180	15	123	5	12