Amino Acid Content of E. Coli and T4 Bacteriophage

		Diss in 200cc E. coli		T4	
dl	Aspartic acid	382.8 mg	9.57%	11.97%	
l	Glutamic acid	191.8 mg	9.59	11.97	
dl	Serine	195.2 mg	4.88	4.77	
	Glycine	158.8 mg	7.94	7.34	
dl	Threonine	212.4 mg	5.31 ✓	7.00	
dl	Alanine	336 mg	8.40	9.40	
dl	Valine	200 mg	5.00 ✓	6.51	
l	Methionine	58.4 mg	2.92 ✓	<1.3	
dl	β alanine	192 mg	4.80 ✓	4.16	
dl	Isoleucine	185.6 mg	4.63 ✓	3.90	✓
l	Leucine	173.6 mg	8.68 ✓	6.51	✓
l	Tryptophane	omit	1.29 (25.8)	——	
l	Proline	60.4 mg	3.02	5.00	
l	Tyrosine	86.6 mg	4.33	3.74	
l	Arginine·HCl	199.0 mg	8.21	6.51	
l	Lysine·HCl·H₂O	227.0 mg	8.26 ✓	8.46	
l	Histidine·HCl	87.8 mg	3.26	<2.6	

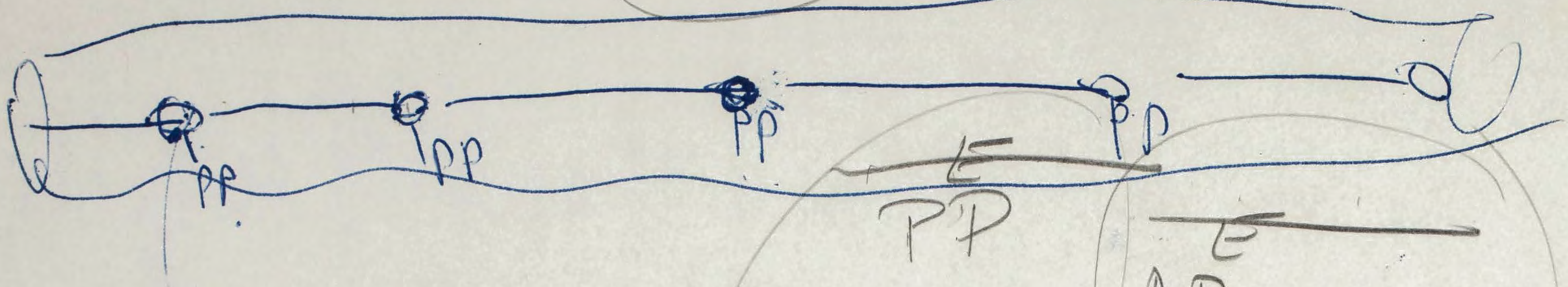
Expressed as % of total amino acids found on the paper and determined by means of partition chromatography.

July 8, 1953

Glucose Experiments ε B/lt

Medium	Machine	T	T5 rate	T6 rate	Quality of Experiment
Broth + 2x phosphate	Breeder #81 Anaerobic	35.7	3.1	2.3	Good
Broth + 2x phosphate	Breeder #82 Aerobic	30.7	3.8	(5.0)	Fair
Broth + 2x phosphate	Breeder #92 Aerobic	33	2.2-2.6	2.6	Good
Casien hydrolysate 1x phosphate	Chemostat #87 Aerobic	37	8.1	3.7	Good
Casien hydrolysate 1x phosphate	Chemostat #88 Aerobic	40	4.0	(2.1)	Fair-Poor
Casien hydrolysate 1x phosphate 50 mg/l Adenosine	Breeder #94 Anaerobic	40	1.6	2.6	Good
Casien hydrolysate 1x phosphate 50 mg/l Adenosine	Breeder #95 Aerobic	32	3.4		Poor
Casien hydrolysate 1x phosphate 50 mg/l Adenosine	Chemostat #93 Aerobic	43	2.4	2.4	Fair-Poor
Casien hydrolystate 1x phosphate 50 mg/l Adenosine	Chemostat #96 Aerobic	33	(2.4)	4.2	Fair-Poor
Casien hydrolystate 1x phosphate 50 mg/l Adenosine	Chemostat #98 Aerobic	42	2.2	3.5	Gopd
Casien hydrolystate 1x phosphate 50 mg/l Adenosine	Chemostat #97 Anaerobic	50	2.4	2.3	Good

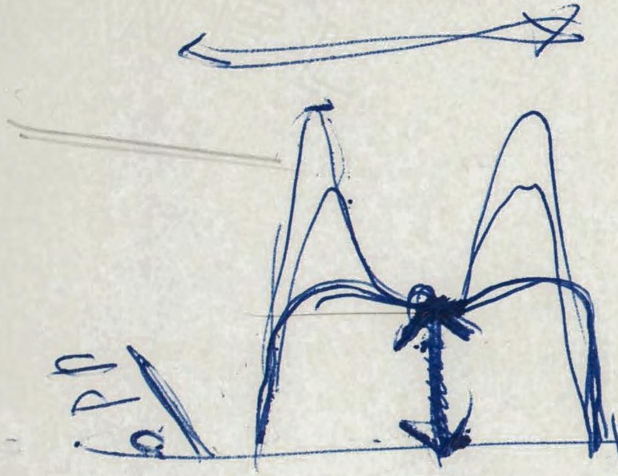
P ≡ A A



E
PP
E
AA

$\Delta F = -RT \ln K$

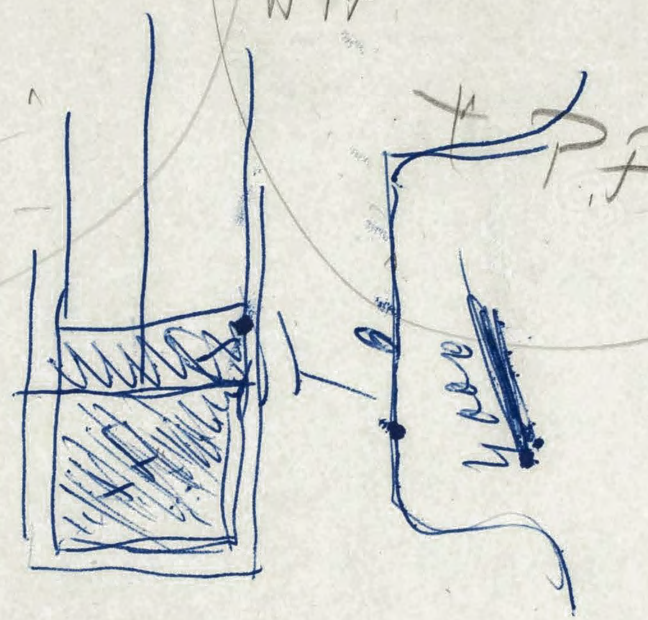
AA
PP



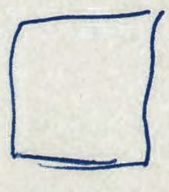
$A + B = AB$

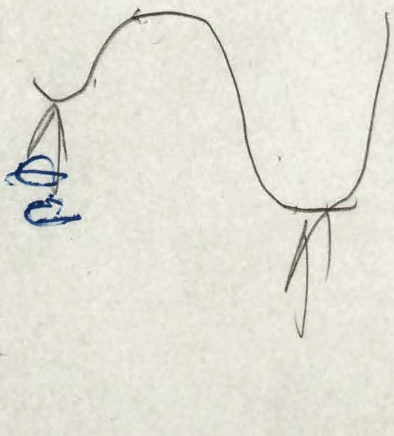
$AB = A + B + Q$

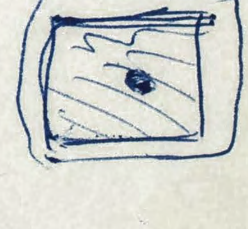
$F = E - ST$



RT ln







$CH_4 + O_2 \rightarrow CO_2$

$\Delta F = H - TS$

$n_1 + n_2 + 2n_{ab} = N$.

if n_{ab} large

$$N = \frac{n_{ab}}{2}.$$

$n_{ab} \rightarrow n_1 + n_2$

$\frac{1}{2}$ $\quad$ $\frac{1}{2}$ $\quad$ $\frac{1}{2}$

$N = 2L$

$$\frac{n_{ab}}{n} = \frac{1}{4}$$

K

$\frac{1}{4}$

$\frac{3}{4}$ / $\frac{1}{4}$ / $\frac{3}{16}$ / 1 / $\frac{9}{16}$

$\frac{3}{4}$ / $\frac{1}{4}$ / $\frac{1}{16}$

$\frac{n_{ab}}{N} = \frac{1}{10}$

$\frac{4}{10}$

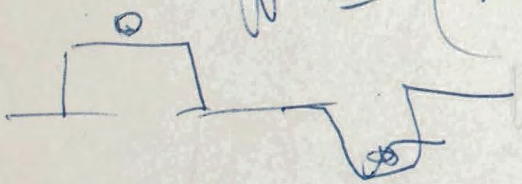
$$F = RT \ln \frac{K_c P}{\frac{n_1 n_2}{n_3} P}$$

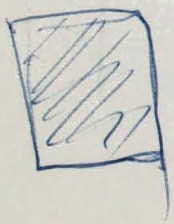
$$F = RT \ln K_c P$$

$$\Delta F = W = RT \left(\ln K_c P_1 - \ln K_c P_2 \right)$$

$$W = RT \ln K_c \left(\frac{P_1}{P_2} \right)^{n-1}$$

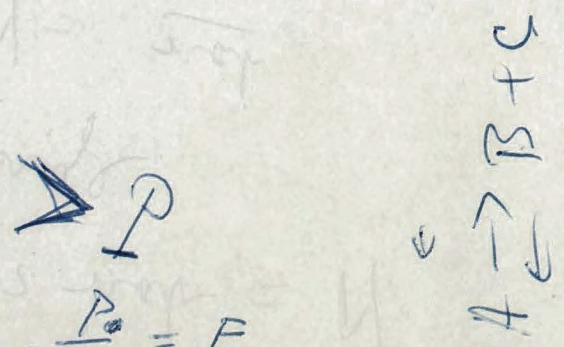
$$W = (n-1) RT \ln \frac{P_1}{n P_2}$$





$P_0 > P$

$R \log \frac{P_0}{P} = E$



$2 \rightleftarrows 2 + 1$

$$K_p = \frac{p_2 p_1}{p_3}$$

$$K_p = \frac{n_2 P \; n_1 P}{n_3 P}$$

$$K_p = \frac{n_2 n_1}{n_3} P$$

K_c

$K_c = RT \ln$

$\Delta F = RT \ln K_c P$

$A \rightarrow n$ products

$(P) = n A P$

P_1

$$\ln \frac{n_{ab}\frac{N}{2} + n_{ab}}{\left(\frac{N}{2}\right)^2 - N n_{ab} + (n_{ab})^2} = \frac{\pm Q}{RT} + 1$$

$$\ln \frac{n_{ab} - \frac{n_{ab}\, n_{ab}}{N}}{\frac{N}{4} - n_{ab} + \frac{n_{ab}}{N} n_{ab}} = \ln \frac{n_{ab}\left(1 - \frac{n_{ab}}{N}\right)}{\frac{N}{4} - n_{ab}\left(1 - \frac{n_{ab}}{N}\right)}$$

$$\ln \frac{\frac{n_{ab}}{N}\left(1 - \frac{n_{ab}}{N}\right)}{\frac{1}{4} - \frac{n_{ab}}{N}\left(1 - \frac{n_{ab}}{N}\right)} = \frac{\pm Q}{RT} + 1$$

$$= Q$$

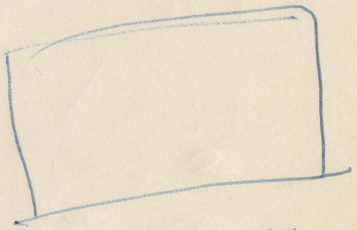
$$n_{ab} R \ln \frac{n_{ab}}{n_1 + n_2 + n_{ab}} + n_1 R \ln \frac{n_1}{\quad} + n_2 R \ln \frac{n_2}{\quad}$$

$$\pm n_{ab} \frac{\mp Q}{T}$$

$$n_{ab} \frac{R}{n_{ab}} \, 1 + R \ln \frac{n_{ab}}{n_1 + n_2 + n_{ab}} = 2 n_1 \frac{R}{n_1} - 2R \ln \frac{n_1}{n_{ab} + n_1 + n_2}$$

$$n_{ab} R \left\{ \ln n_{ab} - \ln n_1 + n_2 + n_{ab} \right\}$$

$$n_1 + n_2 + 2 n_{ab} = N$$



$$2 n_1 = N - 2 n_{ab}$$

$$n_1 = \frac{N}{2} - n_{ab}$$

$$-R + R \ln \frac{n_{ab}}{\langle \; \rangle} - 2R \ln \frac{n_1}{\langle \; \rangle} \pm \frac{Q}{T} = 0$$

$$\ln \frac{n_{ab} (n_1 + n_2 + n_{ab})}{(n_1)^2} = \pm \frac{Q}{RT} + 1$$

$$\ln \frac{n_{ab} (N - n_{ab})}{\left(\frac{N}{2} - n_{ab}\right)^2} = \pm \frac{Q}{RT} + 1$$

$\ln$

$R \ln \frac{n_{ab}}{n_{ab}} + R \ln \frac{n_1}{n_1} + R \ln \frac{n_2}{n_2}$ $+ S_0 n_1 + S_0 n_2 +$

$250 n_{ab} + n_{ab} \frac{Q}{T}$

$(n_{ab} - n_{ab}) \frac{Q}{T}$

T_{AB} S_{AB}

$\frac{dx}{dt} \ln x = \frac{dt}{dt}$

$$\frac{R}{n_{ab}} - \frac{R}{n_1} - \frac{R}{n_2} \pm \frac{Q}{T} = 0$$

$$\frac{RT}{n_{ab}} - \frac{2RT}{n} \pm Q = 0$$

$$\frac{1}{n_{ab}} - \frac{2}{n} = \frac{\pm Q}{RT}$$

$$\frac{1}{n_{ab}} = \pm \frac{Q}{RT} + \frac{2}{n}$$

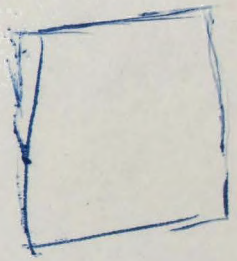
$n_{ab} + 2n =$

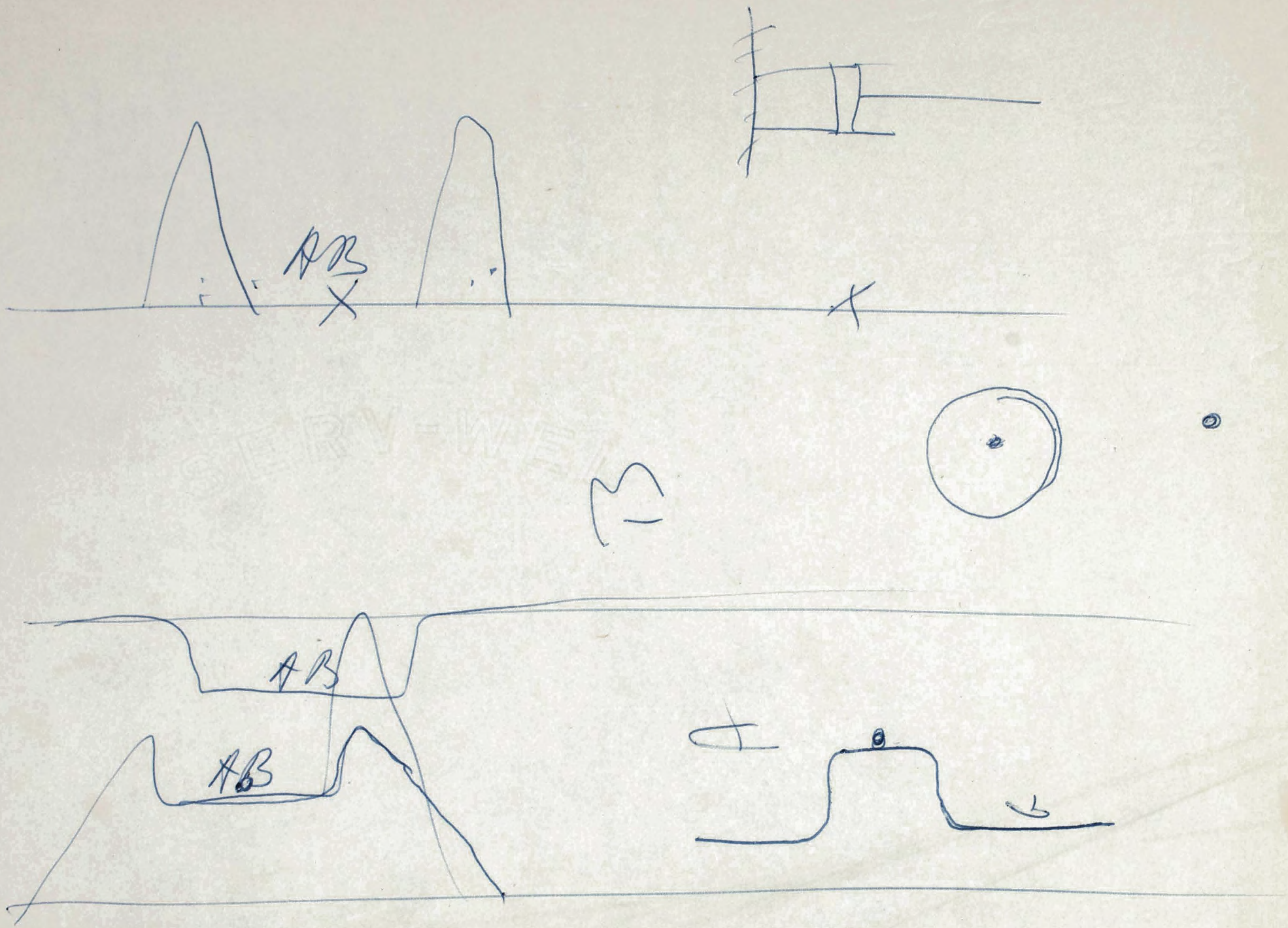
$$n_{ab} = \frac{1}{\pm \frac{Q}{RT} + \frac{2}{n}}$$

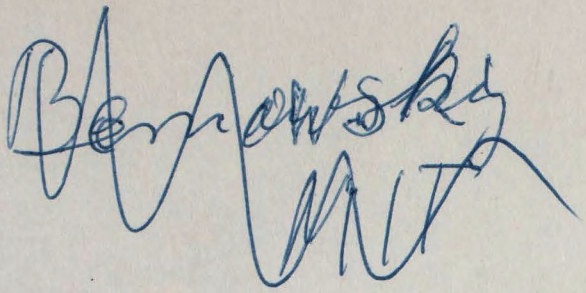
$$n_{ab} = \frac{n}{\pm \frac{Q}{RT} n + 2}$$

$$W = -RT\left(\ln \frac{p_a p_b}{p_{ab}} + \ln \frac{p_a' p_b'}{p_{ab}'}\right)$$

$$W^{A} = -RT\left(\ln K_c P_1 + \ln K_c P_2\right)$$




AB
AB
AB



J. Bronowsky —

MIT

Half-values against ~~theophylline~~

Adenosine	0.4 mg/l	B/it
Guanosine	2.0 mg/l	
Inosine	2.0	
Xanthosine	∞	

Spontaneous

Guanosine ~~50~~ 10–20 mg/l B/it

Adenosine ~~5~~ 2 — 5 mg/l B/2/it

July 21, 1953
SZILARD

B/r/lt Spontaneous Aerobia

Exp	T5	T6	τ	Comments
675				N. G. "Trypdecomposed"
665	4.2	0.88	4.1	F + Glucose
658	3.1	0.65	3.2	F
642	3.63		9.9	F First step in delay exp (60 hr)
641	2.70		2.2	F " " "
618	4.86	1.36	4.45	F
609	4.73	1.0	6.9	F

Omitting 641, 642

Mean T5 rate = 4.22×10^{-8}/hr

Mean T6 rate = 0.97×10^{-8}/hr

B/2/1t + Theophylline

Exp	T5	T6	τ	Comments	
639	16.7	~~22.9~~	2.13		
640	22.9	—	9.4		
636	16.2		5.84	delay expt	60 - 140 ks
635	14.4		10.9	" "	50 - 120
634	15.6		2.64	" "	60 - 140
620	22.3	2.11	4.3		
614	21.8	1.83	4ks		
629	19.4	2.4	4.4	TMC (150 mg/l)	

Mean T5 omitting 634-6 = 20.9×10^{-8}/ks

B/n/it + adenosine

Exp	T5	T6	τ	adenosine	Comments
~~661~~	~~0.57~~	0.42	2.4	10 mg	
660	~~2.56~~	0.59	3.2	5 mg	
659	3.20	0.87	4.01	2 mg/l	
658	3.09	0.65	3.2	0	
619	3.84	1.12	4.6 h	2 mg/l	
612	1.20	0.49	4.4 h	50	

B/n/it + Theoph + adenosine

613	1.36	0.40	4.26 h	150 mg/l theoph	10 mg/l	adenosine

not too important

B/N/it P lim (3 mg/l)

Exp	T5	T6	t	Remarks	
622A	0.65			Bad exp Spent	
623A	0.22	0.13	4.0	50 mg/l adenosine	Good exp
624A	0.55	0.47	3.3	{10 mg/l 150 mg/l theophyllin	~~Poor exp~~ Error
625A	10.6	0.57	3.4	150 theoph	Good exp
623	0.67		3.3	50 mg/l adenosine	Good exp
625	6.21	0.36	3.4	150 theoph	Fair to poor

X-ray expts ~ 90 r/hr

	Exp	T5	T6	τ	Remarks
	B/r/lt				
same geometry as 662 679	670	16.4	11.5	4.2	
	669	NG	14.3	3.01	Many ultra petites in T5
	666	"	9.4		Bad exp in T5
	665	"	11.1		Poor exp in T5
diff geom	537	17.0 ~~14.8~~	12.7 ~~13.8~~	5.7	+500 mg/l guanine
	B/lt/r (I)				
	679	10.9	7.34	4.3	
	662	~15	10.4	4.4	Poor exp

53

Ultraviolet

Exp.	T5	T6	C	I	Remarks
B/1,t					
645	13.6	6.14	4.4	1.5	No light
644	14.3	6.91	2.9	1.5	1/3 light
637	18.2	11.8 Large 7.0 petite	5	1.5	
630A	12.7	3.94(?)	10.7	1.5	
630	16.7	8.26	2.25	1.5	
629A	19.1	7.70	2.8	1.5	
629	21.9	7.17	10.9	1.5	Bad T5 curve.
603-C-1	35.6	10.14	6.5	4	
603-C	12.4	5.34	5.7	1	
603-B	27.9	11.9		3	
672	23.1	9.89	3.8	4.6	
B/1,t/12 (I)					
656	11.9	7.36	7	3	No light
638	9.15	5.42 Large 3.88 Petite		1.5	
628	1.24	0.28	4.7	0	
627	1.14	0.37	4.2	0	
626	0.97	0.28	3.9	0	
B/1,t(-)(667)	15.3	5.2	8.4	4.6	B/1,t(-)
671	33.6	10.4	3.8	4.6	B/1,t(-)/12

Theophylline (ANAEROBIC)

Exp	T5	T6	Z	ASSAY	REMARKS	
682	0.87	3.82	4.6	Held constant @ 2.42. of 681	Glucose (5) plus F	B/1,t
678	2.82	0.75	3.8	Fell. Corrected to 1.53	Glucose (5) Minus Lactate	B/1,t
663	3.09 4.00	0.03 0.07	6.1	Constant but low at 0.60×10^5		B/1,t

Theophylline (AEROBIC)

681	14.7	0.92	4.5	Constant at 3.26 of. 682	Glucose (5) Plus F	B/1,t
677	4.1	1.0	6.9	Fell. Corrected to 1.25	Glucose (5) Minus Lactate	B/1,t

Spontaneous (ANAEROBIC)

676	0.73	0.58	4.6	Fluctuated low. Corrected to 10^5	Glucose (5) Minus lactate	(Poor Exp.)	B/1,t
664	−0.19	0.34	4.7	Constant at 2.54	Glucose (5) Plus Lactate		B/r/1,t
651	0.60	0.50	3.5	Fell. Corrected to 10^5	Glucose (10) Minus Lactate		B/r/1,t
648	0.25	0.00	3.0	Fell slowly Corrected to 10^5	Glucose (5) Minus Lactate		B/r/1,t
643	0.19	0.07	6.0	Fell slowly.	Glucose (5) Minus Lactate		B/1,t

Spontaneous (AEROBIC)

675	0.80	0.50	4.3	Fluctuated low. Corrected to 10^5	Glucose (5) Minus Lactate	(Poor Exp.)	B/1,t
665	4.2	0.88	4.1	Held constant at 3.20	Glucose (5) Plus Lactate		B/r/1,t
647	1.46	0.76	5.0	Fell. Corrected to 2.46	Glucose (5) Minus Lactate		B/1,t

9/22/53

X-RAY

			T5	T6
			$\times 10^{-8}$/hr	
Exp # 689 - B/r/1,t	Co SOURCE $\tau = 3.6$	ANAEROBIC GLUCOSE 5gm/L	7.02	5.37
# 684 - B/r/1,t	Co SOURCE $\tau = 4.0$	AEROBIC GLUCOSE 5gm/L	17.9	11.1

ULTRA-VIOLET

			T5	T6
# 683 B/r/1,t	U.V. (I=3) $\tau = 4.1$	AEROBIC GLUCOSE 5gm/L	14.9	5.58
# 688 B/r/1,t	U.V. (I=3) $\tau = 4.1$	ANAEROBIC GLUCOSE 5gm/L	13.6	7.65

THEOPHYLLINE

			T5	T6
# 687 B/1,t	Theoph. = 150 mg/L $\tau = 4.7$	ANAEROBIC GLUCOSE 5gm/L ~~+ lactate~~ + F	0.60	0.36
# 685 B/r/1,t	Theoph. = 150 mg/L $\tau = 4.2$	ANAEROBIC GLUCOSE 5gm/L + F	1.10 ~~1.35~~	1.35 ~~1.10~~

ADENOSINE

			T5	T6
# 686 B/r/1,t	Adenosine = 50 mg/L $\tau = 4.7$	ANAEROBIC GLUCOSE 5gm/L + F	0.628 ~~0.847~~	0.847 ~~0.628~~

52 B/1, t's were found out of a total of 96 cultures of B plated on T1. None of these 52 B/1, t's were found to pour out substance "X" when tested under U.V. They were grown on 5mg/l tryptophan.

Mr.
Meadows

Tuesday
March 28th
4 pm

Measure an arginine uptake of tryptophanless strain

1.) Maintained a tryptophanless strain in the chemostat, with different arginine inputs. — Arginineless strain is washed out at different rate. ~~We know~~ ~~In~~ This rate gives us for each experiment at what rate the arginineless grows. Because curves. The input concentration tells us what fraction of the arginine contained

In the hypoxanthineless strain, comes from the outside, ~~and that~~ the remainder being synthesized by B/tt. —

2.) a hypoxanthineless strain is maintained in the chemostat together with an arginineless strain. The arginine input concentration is larger than that necessary to supply all the arginine contained in the hypoxanthineless strain. The arginineless strain is determined and this gives us how much of the arginine contained in the hypoxanthineless strain is synthesized by the strain the remainder being taken up from the medium.

T.... pries as the arg reduce 3.)
concentration from curve xx.—

T is about

Exp 4093–4213

Feed (by)	Maker	τ	$\frac{1}{\alpha}$	C (avg)
1150 γ/l = 0.5	0.5	7.4 hr	3.37 hr	0.44 γ/l
690 = 0.3	0.7	8.0 hr	4.29 hr	0.35 γ/l
230 = 0.1	0.9	7.9 hr	5.88 hr	0.26 γ/l
0 = 0	1.0	8.6 hr	11.9 hr	0.12 γ/l

Lentime of observed straight line T

$$\frac{1}{T} = \alpha - \frac{1}{\tau}$$

to compute α from T

$$\alpha = \frac{1}{T} + \frac{1}{\tau}$$

$$\frac{d}{dt} \ln n = \frac{1}{n} \frac{dn}{dt} = \alpha - \frac{1}{\tau} = \frac{1}{T}$$

T is the slope on n plotted against time

1

Healing of tryptophane

by Argininaless Exp. 284

(Novick ~~?~~ Oct 1951) page 1.

2.3 mgm/l Arg. (1 unit)
100 γ/l trypt. (½ unit)

$\tau = 6.5$ hours

B/lt (2 assays) with T_1 4.71×10^7
(with no D84/6)

~~[illegible]~~ D84/6 added:

τ changed to 2.5 hours

~~[illegible]~~ (2 assays) with T_1 $3.08\ 10^7$
" " T_6 2.49×10^8

~~[illegible]~~

$\tau = 3.875$

2 assays with T_1: 5.06×10^7
" " $T_6 = 2.75\ 10^8$

repeat:
(reautoclaved) with no D84/6
at $\tau = 3.1$ h
1 assay $T_1 = 4.39 \times 10^7$

D 84/6 added

$\bar{\tau} = 2.1$ hours

Passes with $\bar{T}_1 = 2.44 \times 10^7$
with $\bar{T}_6 = 2.79\ 10^8$

$\bar{\tau} = 1.96$ hours

Passes with $\bar{T}_1$ 2.48×10^7
with $\bar{T}_6$ 2.48×10^8

$\bar{J} = 2.98$ hours

Passes with $\bar{T}_1$ 4.06×10^7
with $\bar{T}_6$ 2.49×10^8

Stealing of arginine ①

By B/1t Exp. 319
(see No 3)

1.3 units of arginine

500

W84 is a B from Doermann
arginineless (via Witkin)
This grown with 2.3 mgm/l
arginine gives the
same Beckmann at 350
as 5 ad/l of Tryptophane
free with B/1t. Therefore
1 unit of Arginine
is 2.3 mgm/liter
This checks with amino
acid analyses of coli

6-26
1946

2.)

according to Wyckoff

Coli has 1.29% Tryptophane
8.21 Arginine

ratio $\frac{8.21}{1.29} = 6.4$

whereas we have $\frac{2.3}{0.5} = 4.6$

or ≈ 5.5

Control 318
100γ/l trypt
600γ/l Arg.

only Δ84/6

viable 5 assays: 7.22×10^7

Exp 319 Δ84/6 + B/t

100γ/l Trypt
600γ/l Arg τ = 2.4 hours   assay with T1 >

2 assay with T6 3.77×10^7 || 5.16 10

3.)

Total assay 8.89 $\times 10^7$

~~3.77~~
~~5.26~~
~~8.99~~ 8.4

later on

with T_1 4.41 $\times 10^7$

with T_6 2.84 (2 assays)

later

with T_1 5.30

3.24 (2 assays)

I changed from 2.4 hr to 6.3 hours:

1 assay with T_1 4.04×10^7

with T_6 $5.07 \cdot 10^7$

Plus was all done

with DS4