

archiv
72989

Report No. UM-HSRI-82-33-3

QUANTIFICATION OF THORACIC RESPONSE AND INJURY:
THE GATHERING OF DATA
APPENDIX B. RIB TEST DATA.

FINAL REPORT. CONTRACT DOT-HS-4-00921

Prepared by:

D. H. Robbins, R. J. Lehman, G. S. Nusholtz, J. W. Melvin,
J. B. Benson, R. L. Stalnaker, R. Culver
Highway Safety Research Institute
Institute of Science and Technology
University of Michigan
Ann Arbor, Michigan 48109

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
Washington, D.C. 20590

Date:

August 31, 1982

Technical Report Documentation Page

1. Report No.		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle QUANTIFICATION OF THORACIC RESPONSE AND INJURY. THE GATHERING OF DATA. APPENDIX B. RIB TEST DATA.				5. Report Date August 31, 1982	
				6. Performing Organization Code	
7. Author(s) Robbins, D.H., Lehman, R.J., Nusholtz, G.S., Melvin, J.W., Benson, J.B., Stalnaker, R.L., Culver, R.				8. Performing Organization Report No. UM-HSRI-82-33-3	
9. Performing Organization Name and Address Highway Safety Research Institute Institute of Science and Technology University of Michigan Ann Arbor, Michigan 48109				10. Work Unit No.	
				11. Contract or Grant No. DOT-HS-4-00921	
12. Sponsoring Agency Name and Address U. S. Department of Transportation National Highway Traffic Safety Administration Washington, D.C. 20590				13. Type of Report and Period Covered Final July 1974 - August 1982	
				14. Sponsoring Agency Code	
15. Supplementary Notes					
16. Abstract This report is Appendix B to the main report entitled "Quantification of Thoracic Response and Injury. The Gathering of Data." Included are force-deflection curves for rib samples taken from cadaver test subjects. These are supplemented by photographs of the cross-sections of the same samples. In addition to the main report and Appendix B, there is an Appendix A which contains complete impact test reports for the subjects. This package of reports presents methods and results for a series of 84 thorax impact tests using human cadaver subjects.					
17. Key Words Impact Test Thorax Injury Human Tolerance				18. Distribution Statement	
19. Security Classif. (of this report)		20. Security Classif. (of this page)		21. No. of Pages	22. Price

NOTICE

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for the contents or use thereof.

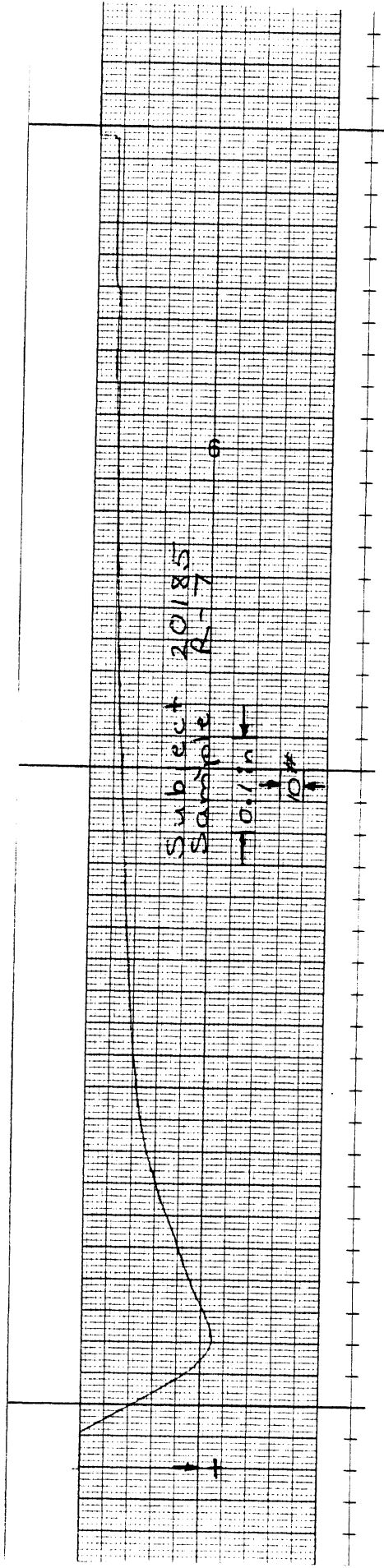
INTRODUCTION

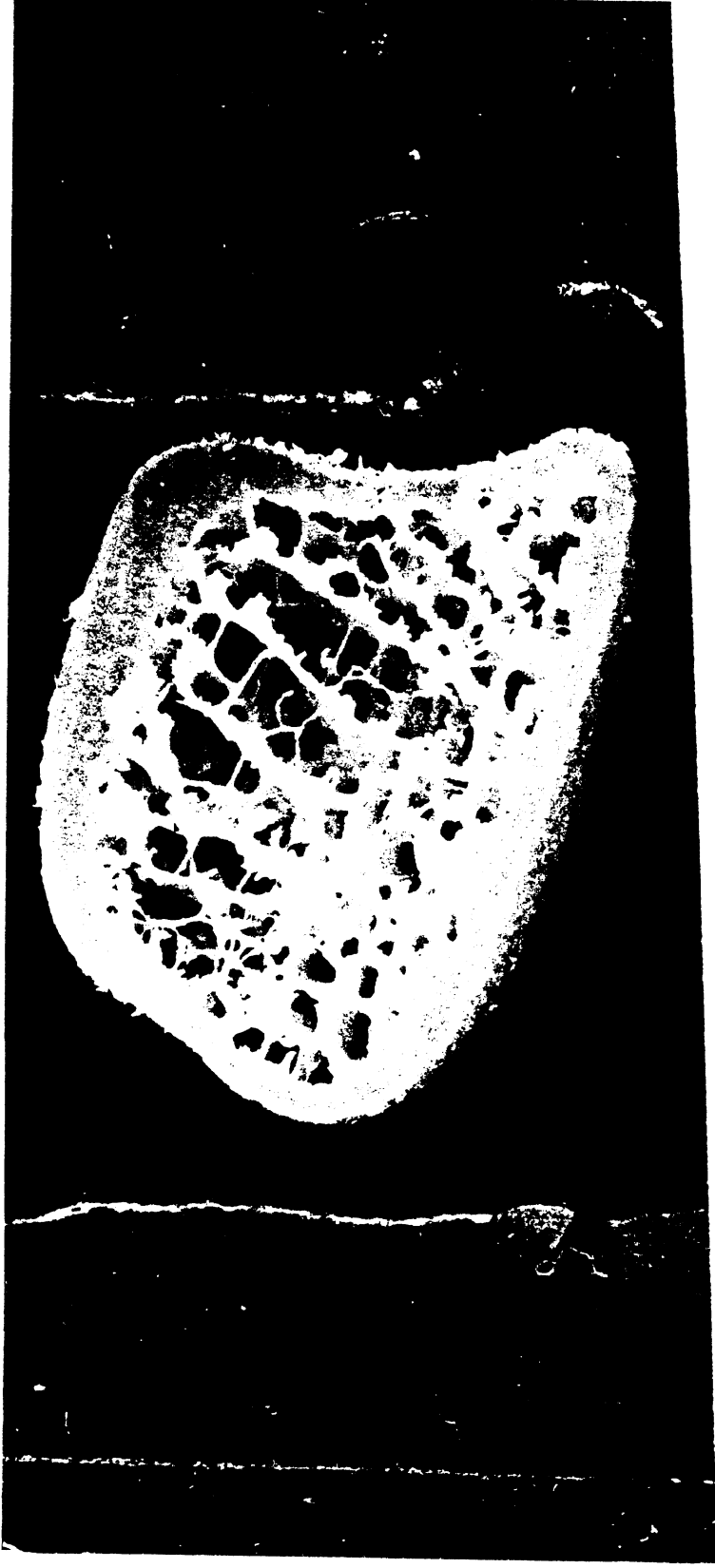
This report is Appendix B to the main report entitled "Quantification of Thoracic Response and Injury. The Gathering of Data." Included are force-deflection curves for rib samples taken from cadaver test subjects. These are supplemented by photographs of the cross-sections of the same samples. In addition to the main report and Appendix B, there is an Appendix A which contains complete impact test reports for the subjects. This package of reports presents methods and results for a series of 84 thorax impact tests using human cadaver subjects.

The rib samples which were tested are identified by a subject number. The following table lists the project test number for each subject.

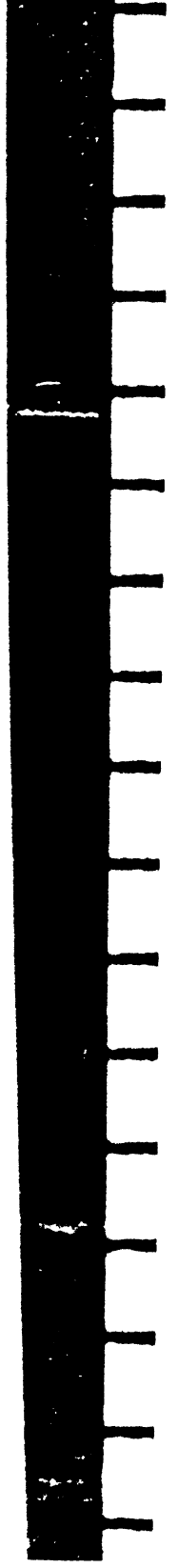
TABLE 1. TEST NUMBER VERSUS SUBJECT NUMBER

Test	Subject	Test	Subject	Test	Subject
A868	20185	76T025	20496	77T077	20777
A883	20219	76T029	20523	77T080	20788
A937	20335	76T039	20541	77T083	20800
76T003	20375	76T050	20597	77T086	20806
76T008	20414	76T053	20606	77T089	20818
76T009	20423	76T056	20616	77T092	20822
76T010	20441	76T059	20615	77T095	20837
76T011	20445	76T062	20621	77T098	20853
76T020	20476	76T065	20629		
76T021	20487	77T068	20761		
76T022	20489	77T071	20765		
76T024	20494	77T074	20774		





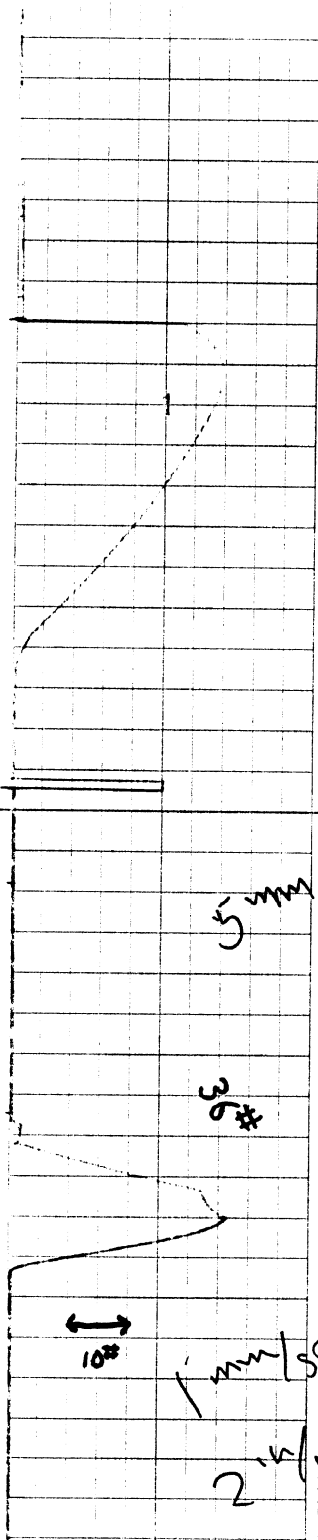
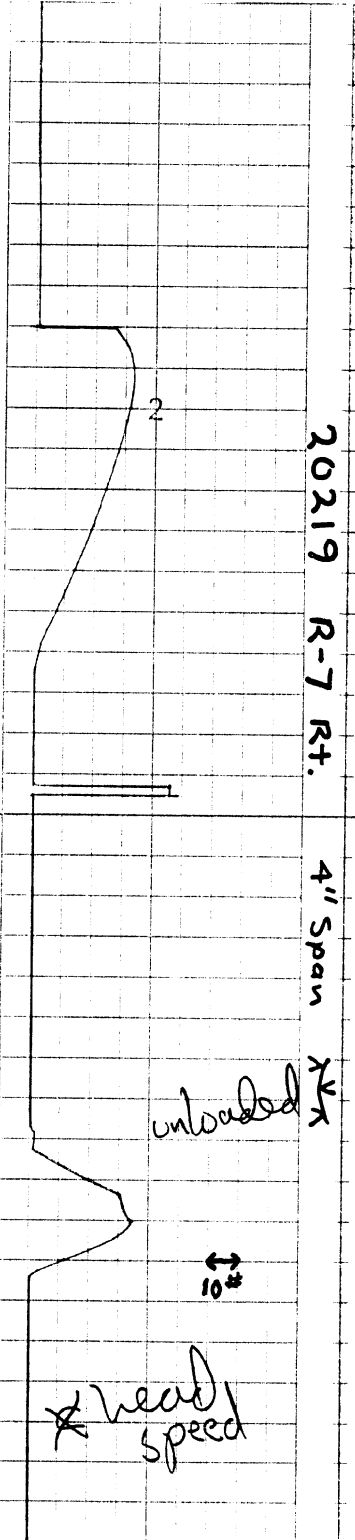
20185 R7



20219 R-7 Rt.

4" Span

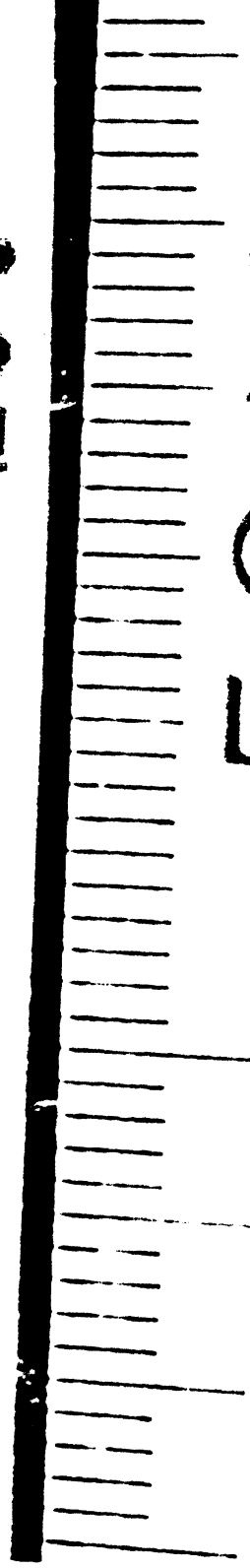
X/K



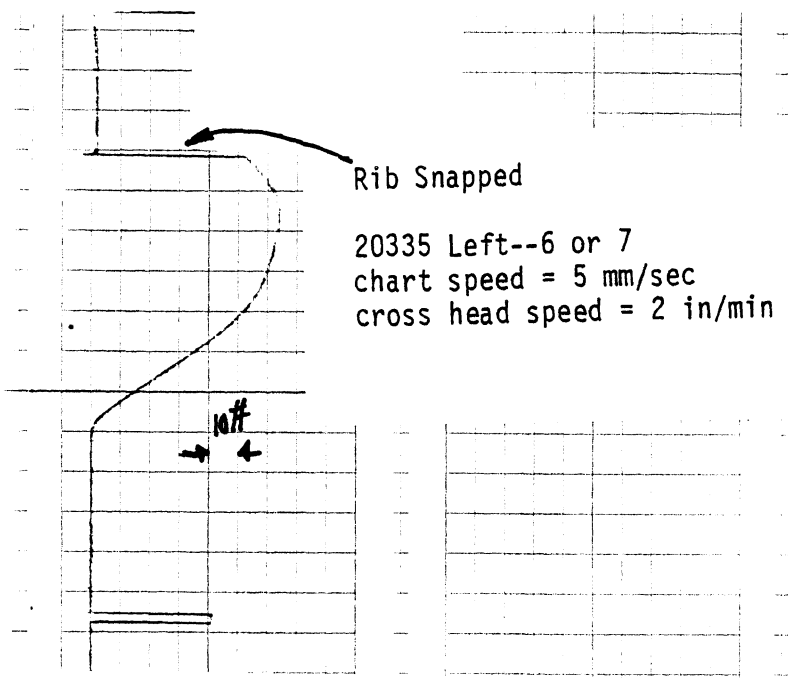
LEVITE CORPORATION / BRUSH INSTRUMENTS DIVISION
CLEVELAND, OHIO
PRINTED IN U.S.A.



20219 R7



50ths

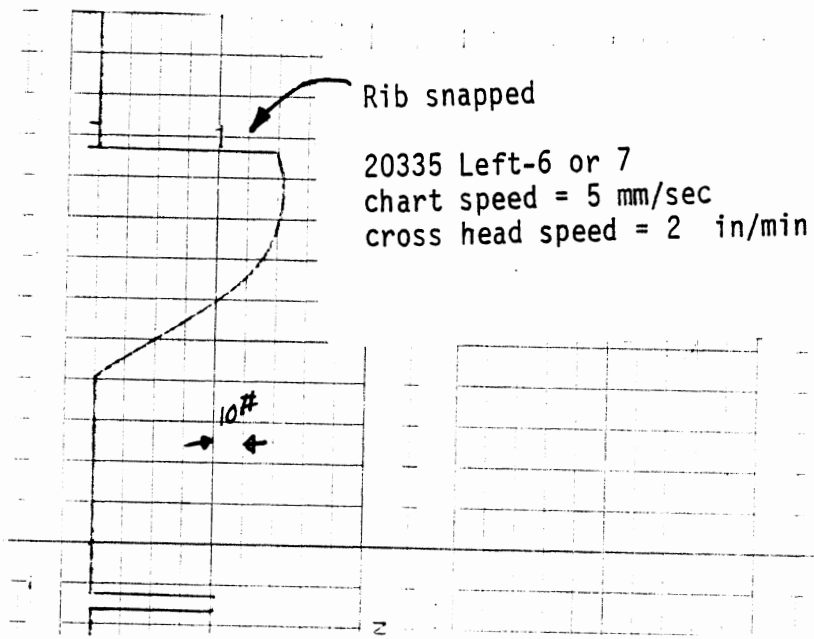




20335 L6

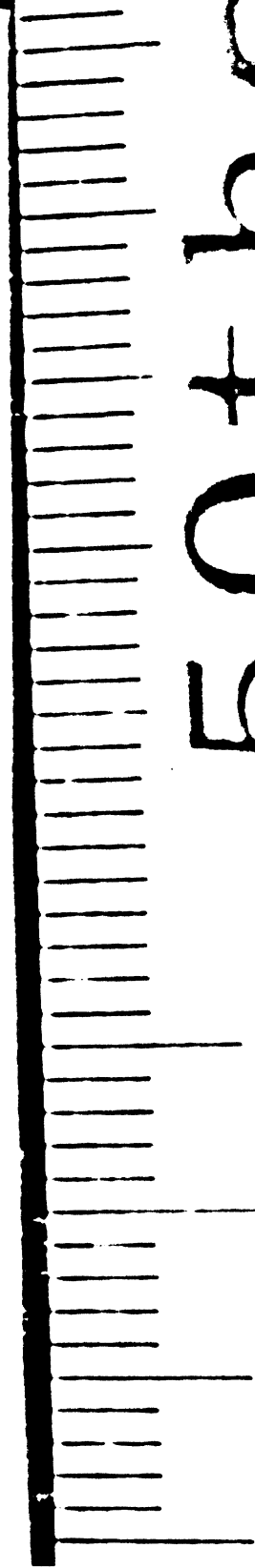


50t1

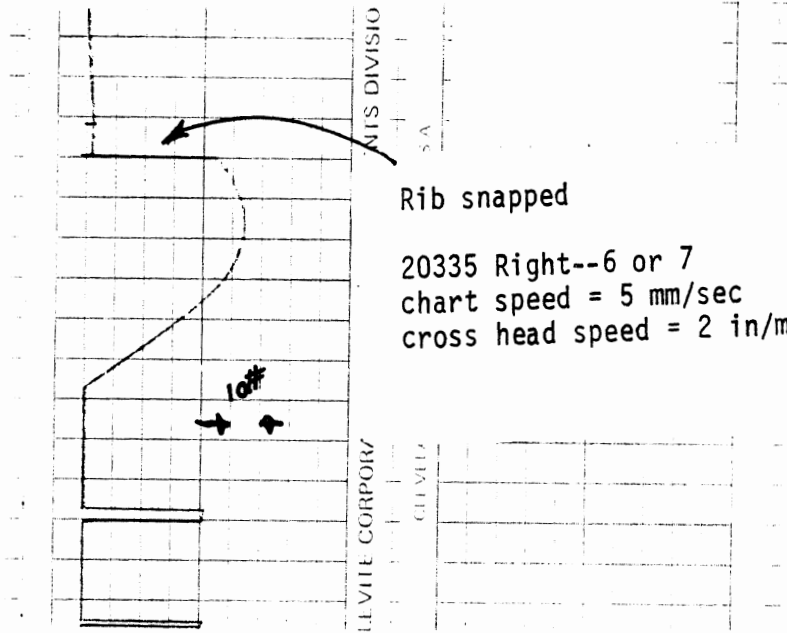




20335 I17



50ths

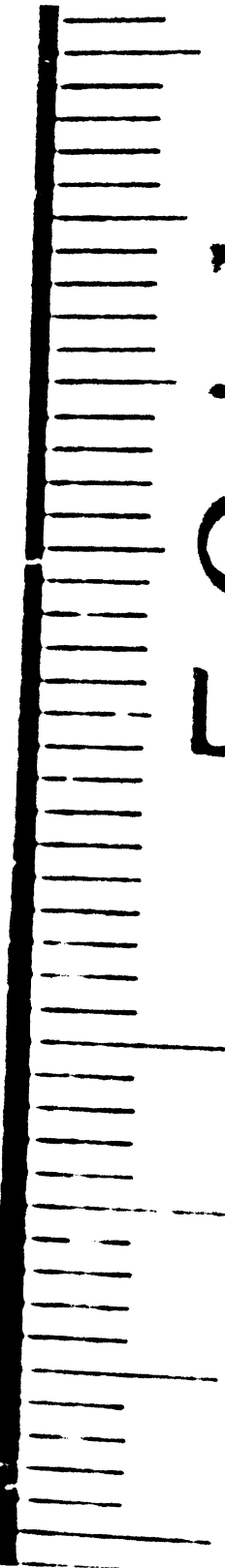


Rib snapped

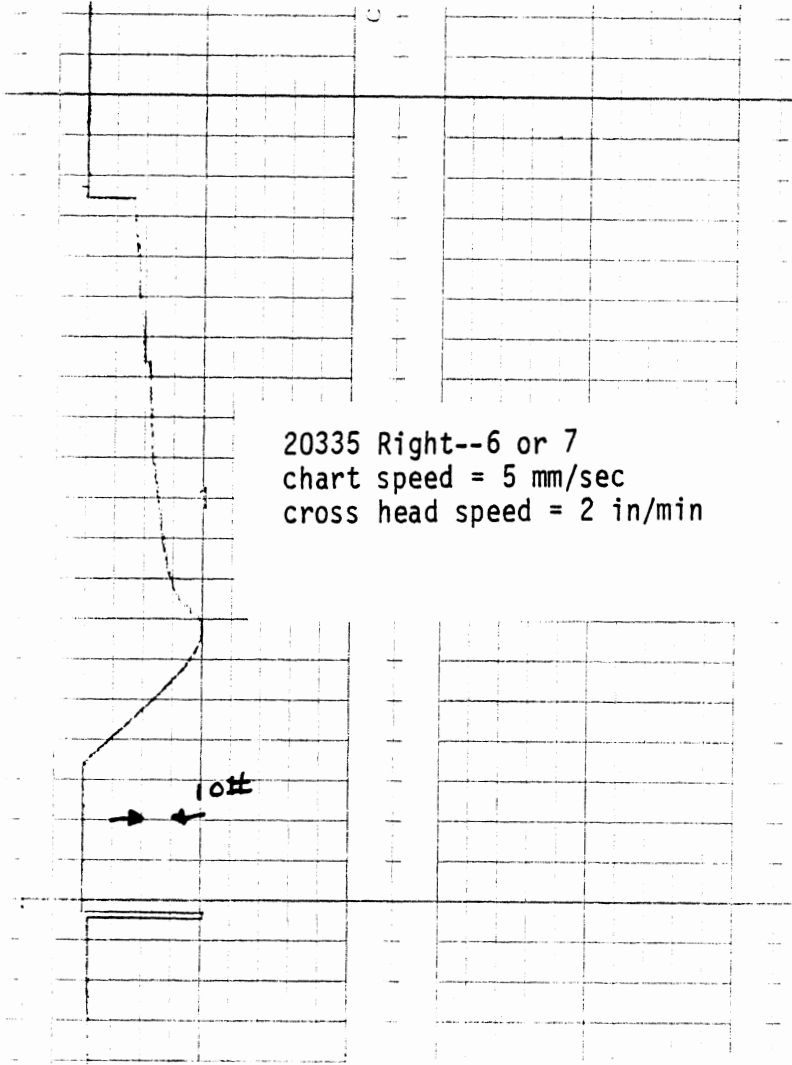
20335 Right--6 or 7
chart speed = 5 mm/sec
cross head speed = 2 in/min



20335 RG

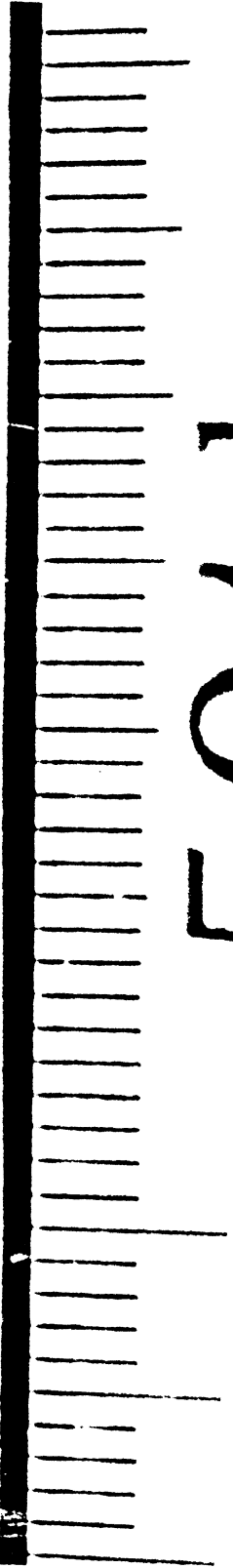


50ths





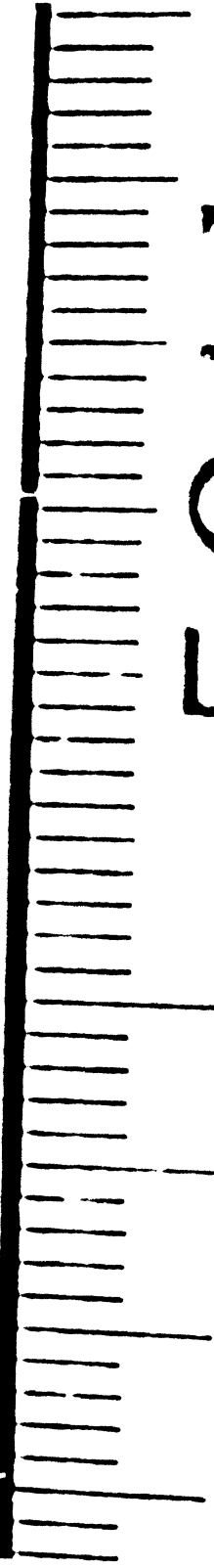
20335 R7



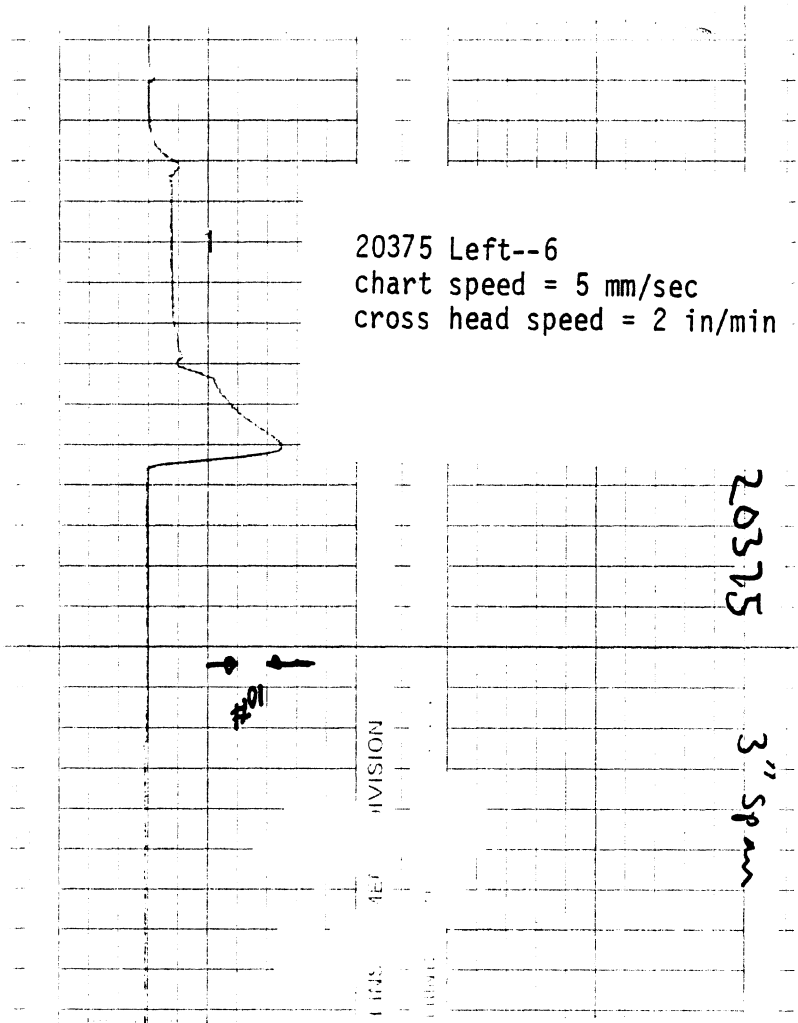
FOR



20335 R7



50thz



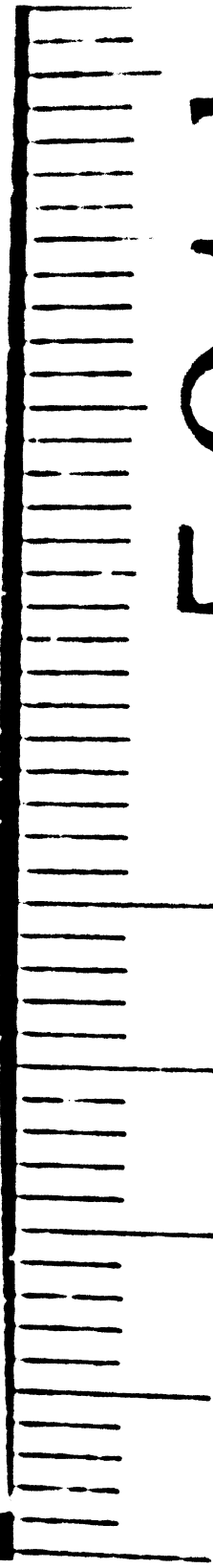
20375 Left--6
 chart speed = 5 mm/sec
 cross head speed = 2 in/min

20375

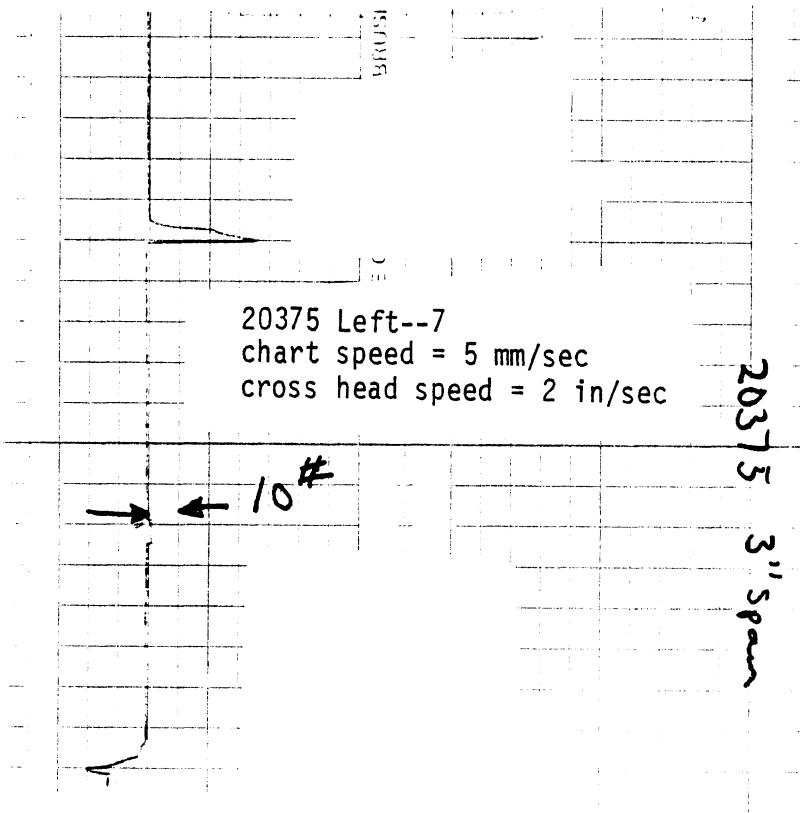
3" span



20375 L6



50th



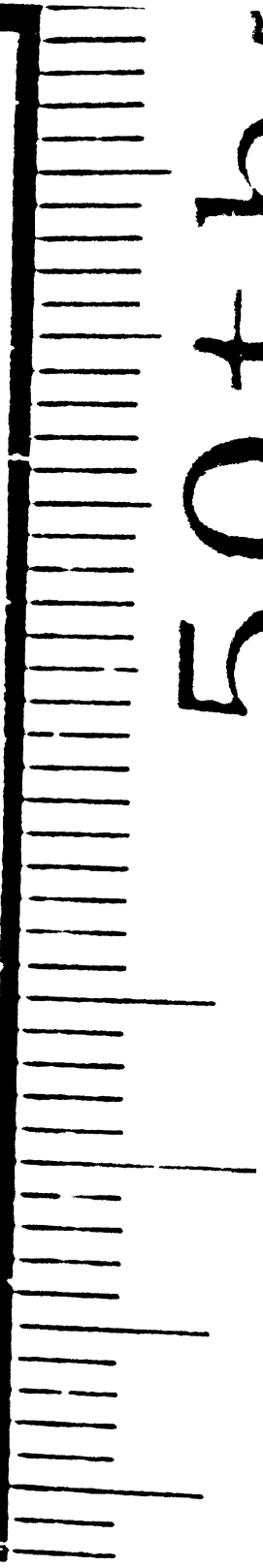
20375 Left--7
chart speed = 5 mm/sec
cross head speed = 2 in/sec

10#

20375 3" span



20375 I77



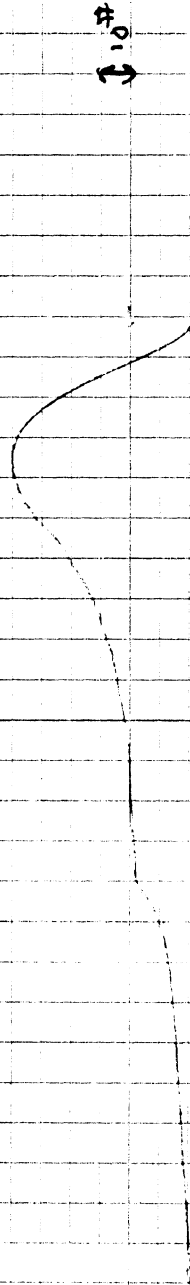
50+hr

20375 R-6 Rt. 3" span

x-head 3 ipm

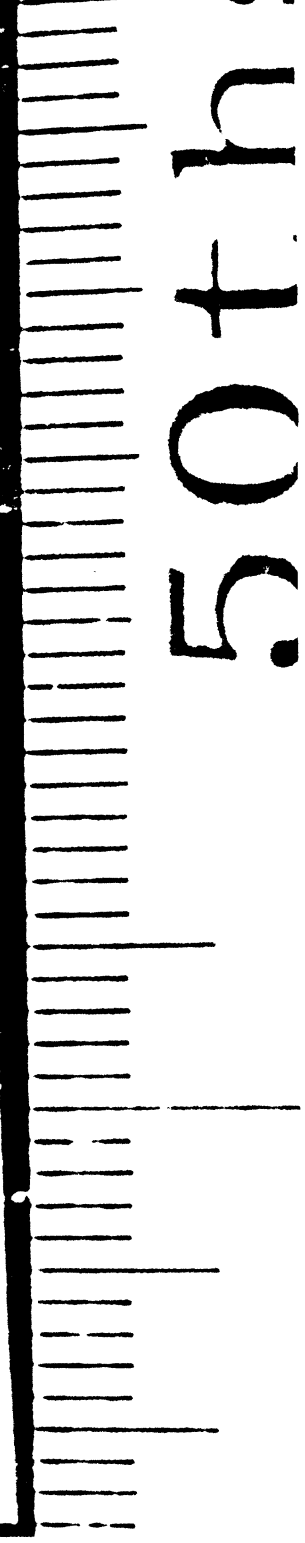
chart 5 mm/sec

CLEVITE CORPORATION / BRUSH INSTRUMENT
CLEVELAND OHIO PRINCETON N.J.

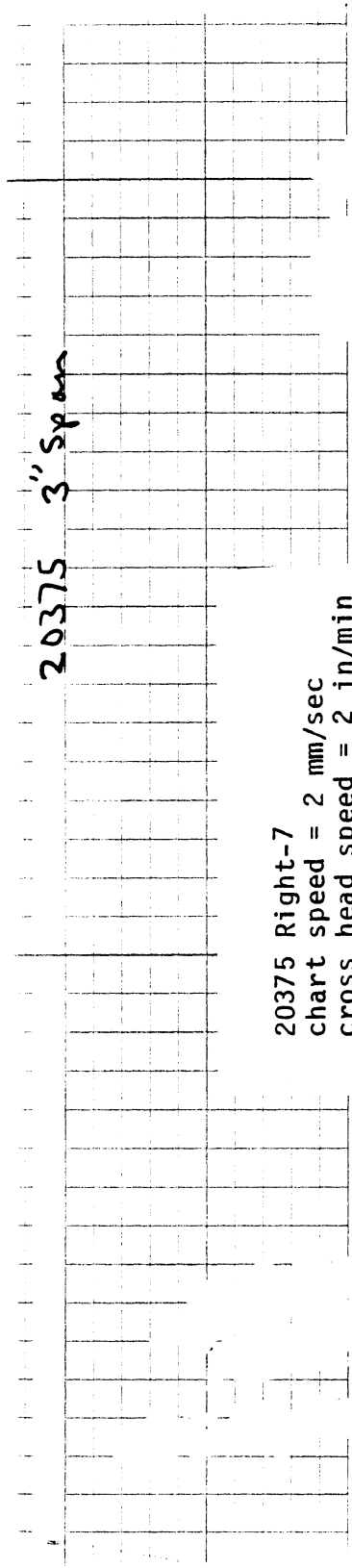




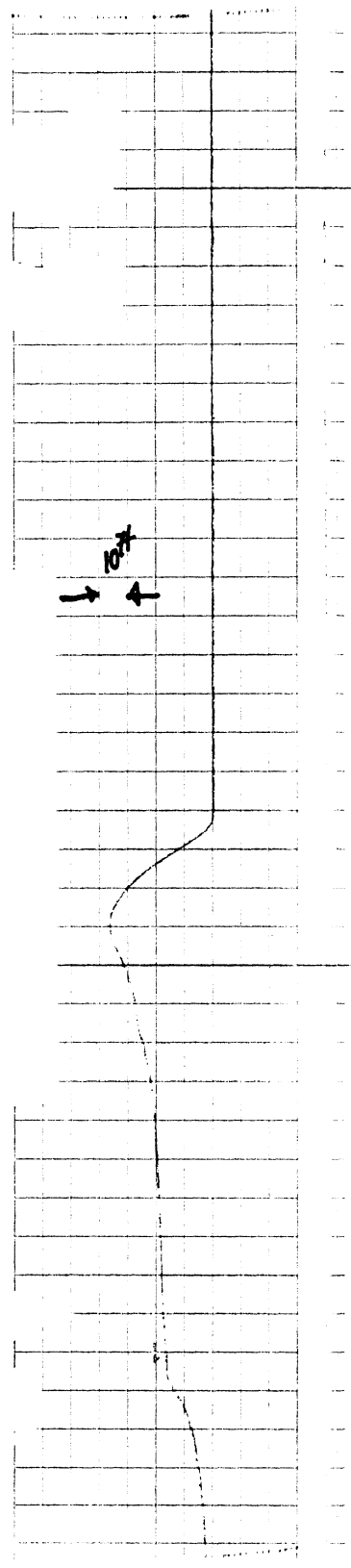
20375 R6



50th

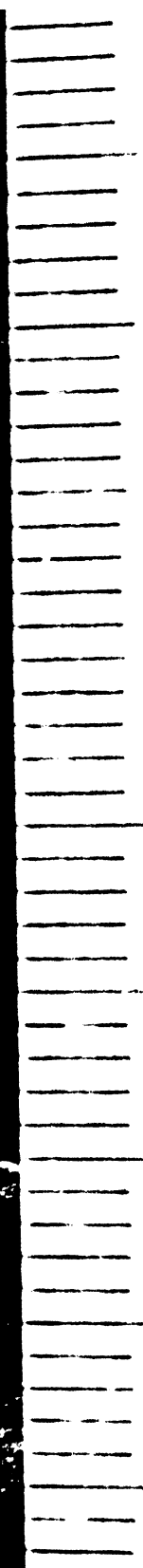


20375 Right-7
chart speed = 2 mm/sec
cross head speed = 2 in/min

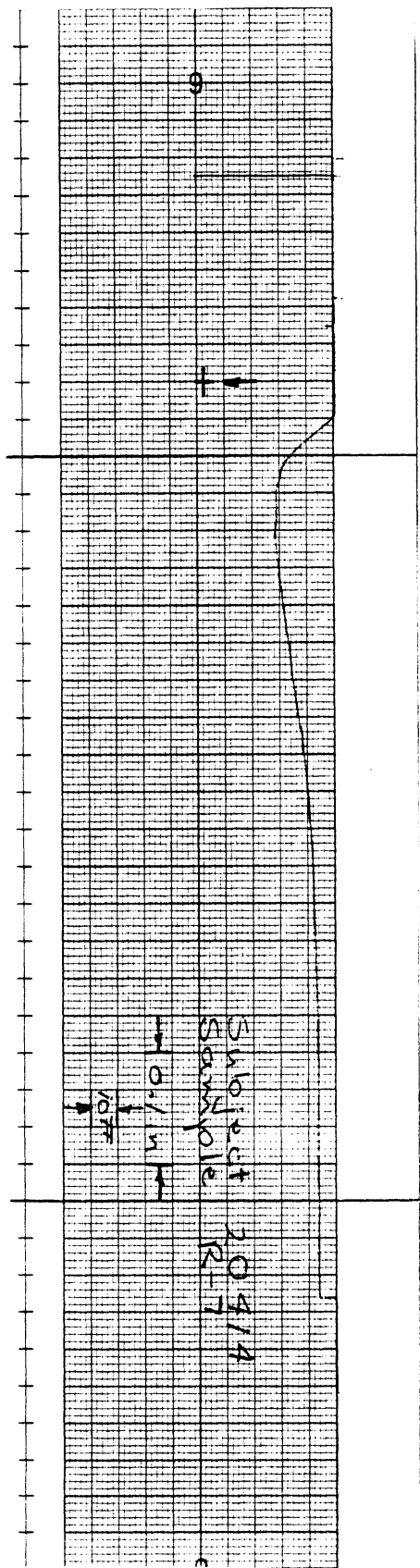




20375 R7



5041





2041A R7

INMURC

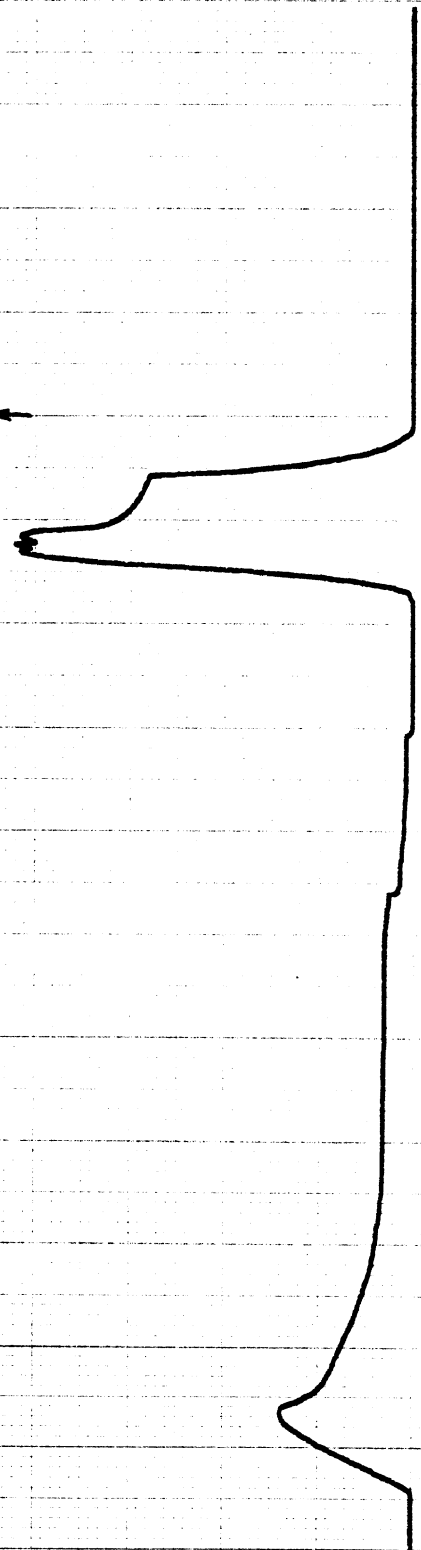
11

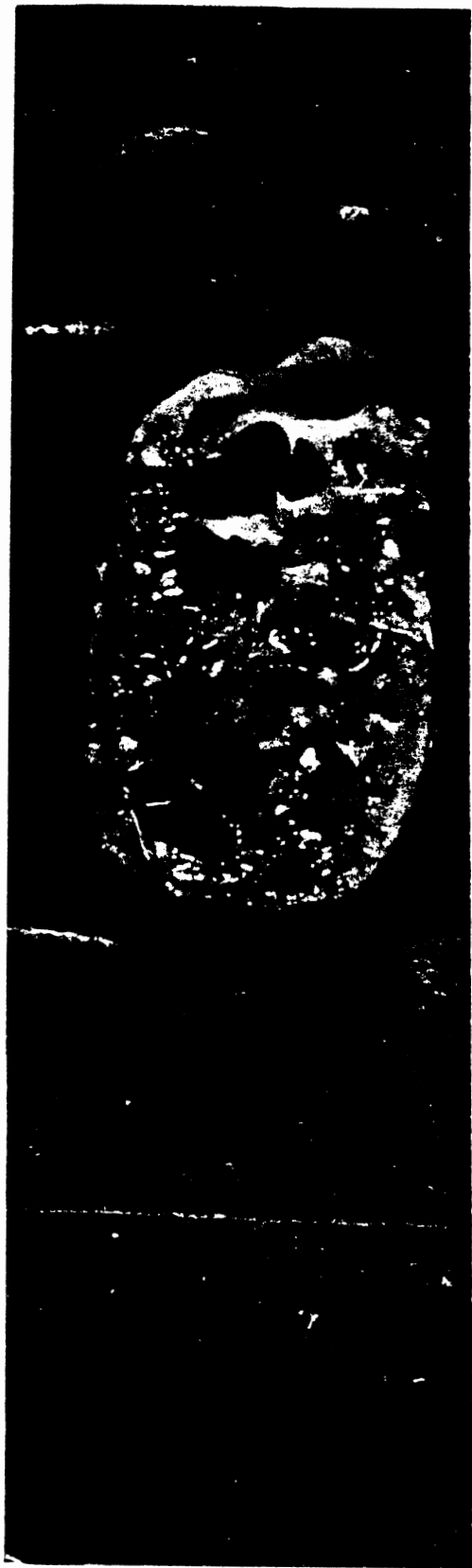
Subject 20423
Sample LG

10#

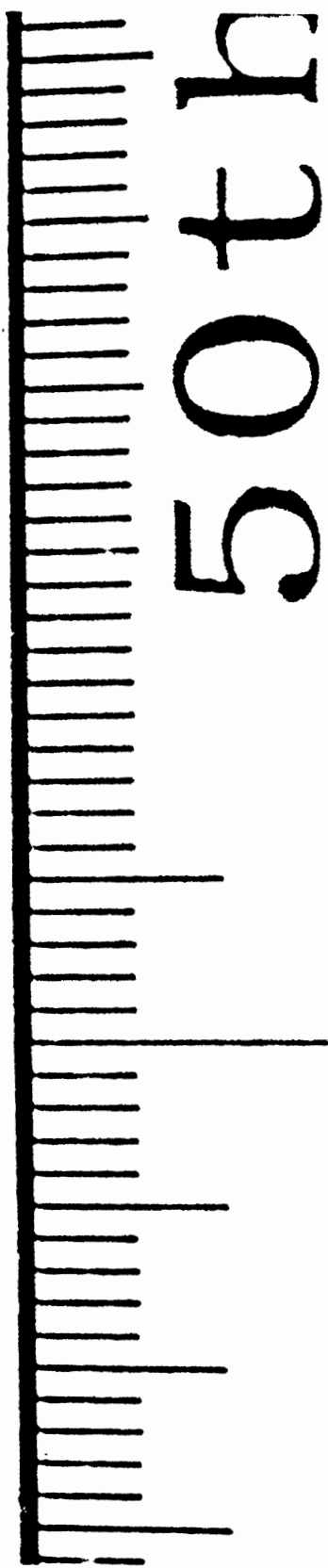
1/3 in.

+





20423 I6



Subject 20423

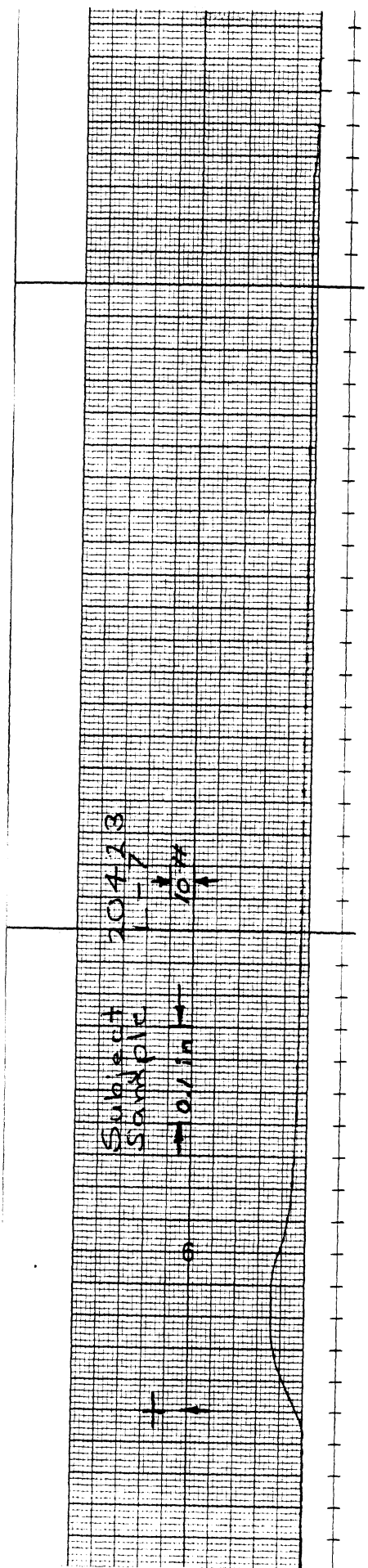
L-7

10:4

Subject
SAMPLE

10:10

T





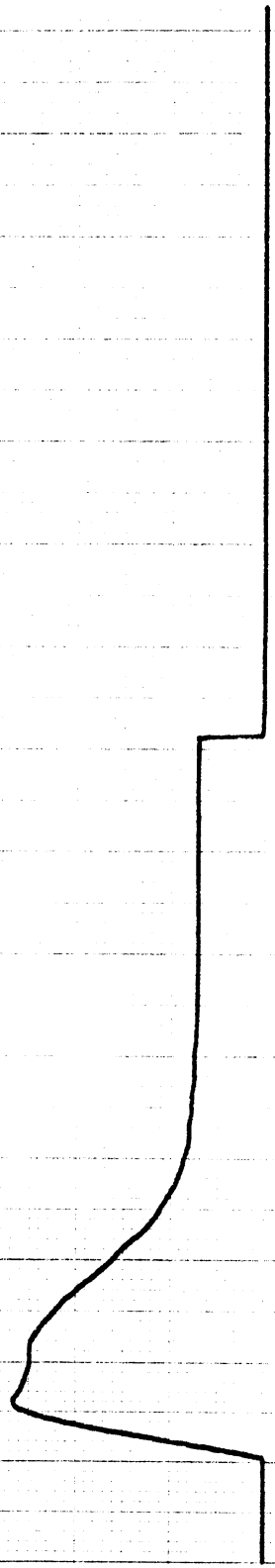
20423 I77



INCHES

1

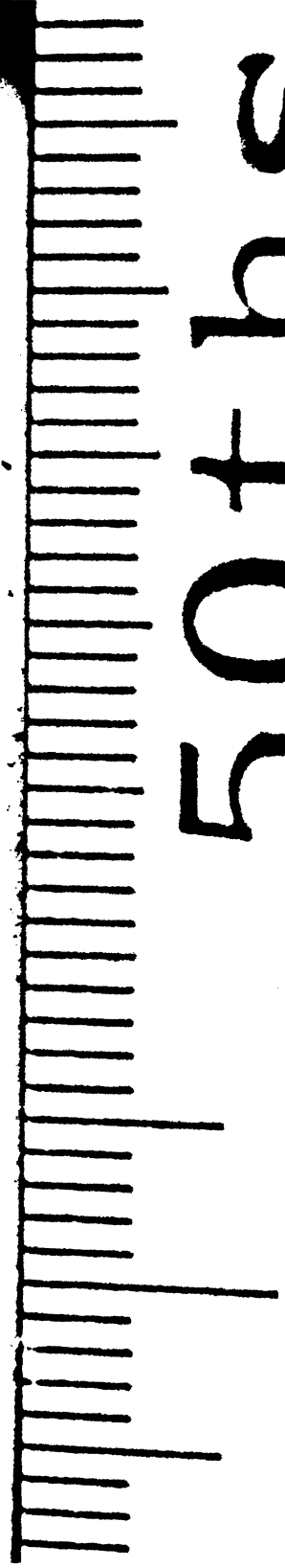
Subject 20441
Sample L6
→ 1/3 inch ←
↓ 10# ↓



← + →

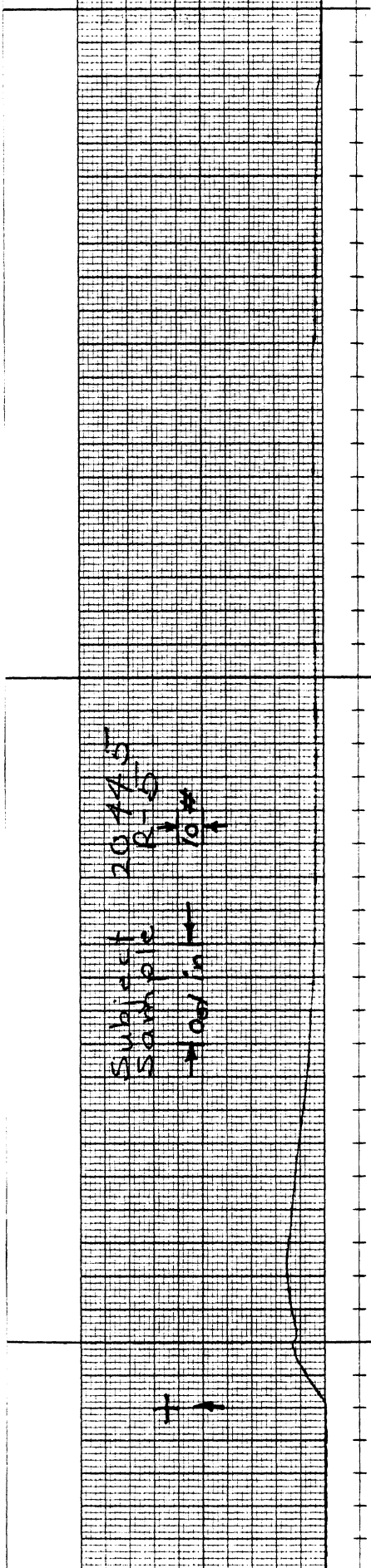


20441 R6



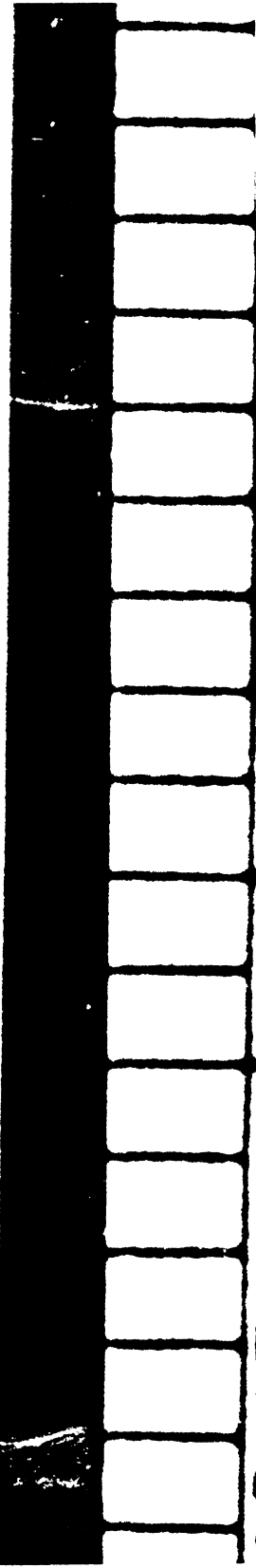
Subject 20445
Sample R-5
10/10

10/10



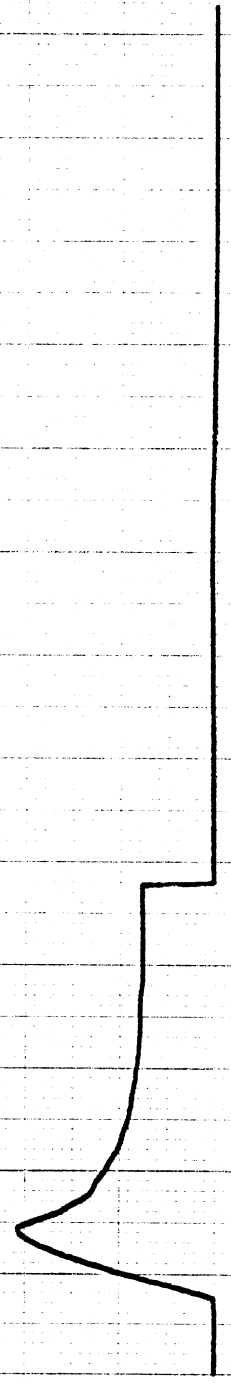


20445 R5



Subject 2047G
Sample L7
→ 1/3 inch ←
← 10# →

+ →





76T020 L7



50ths

Subject 20487
Sample RG

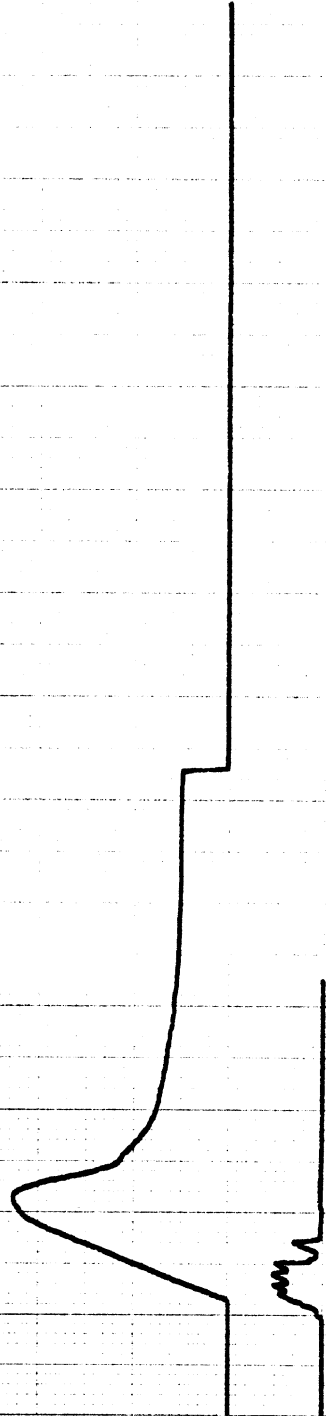
→ 1/8 inch ←

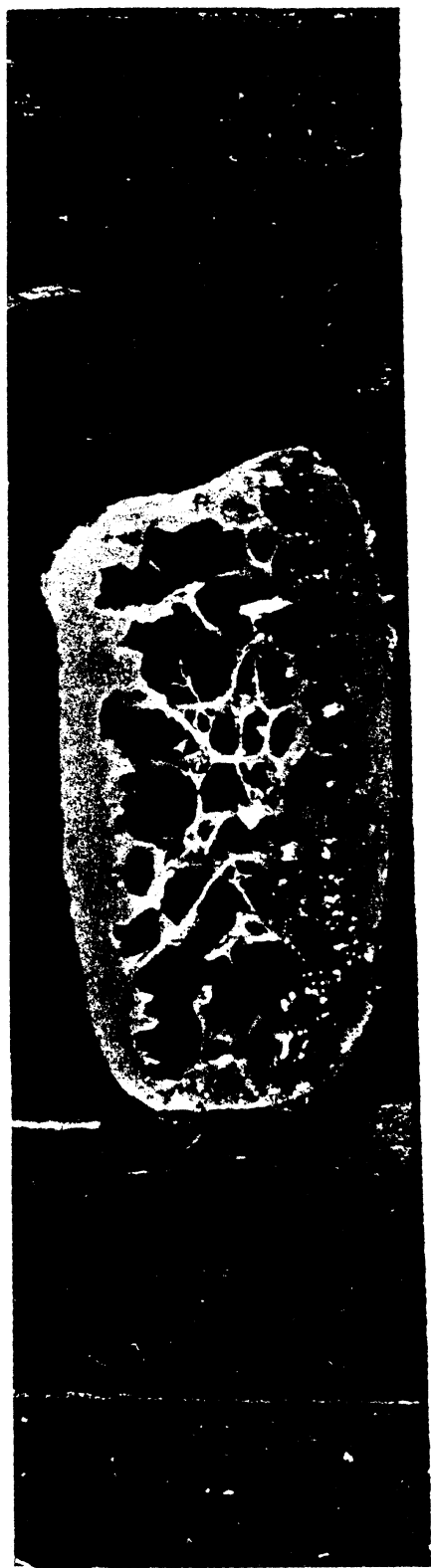
↑ ↓

10#

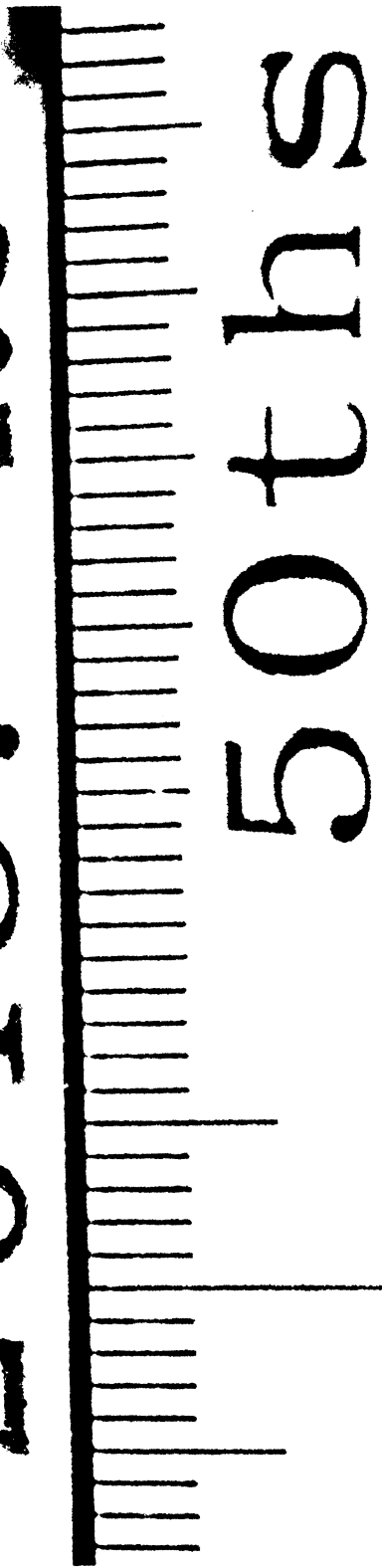
↑ ↓

+ ↑





20487 R6



50ths

SUBJECT 20187

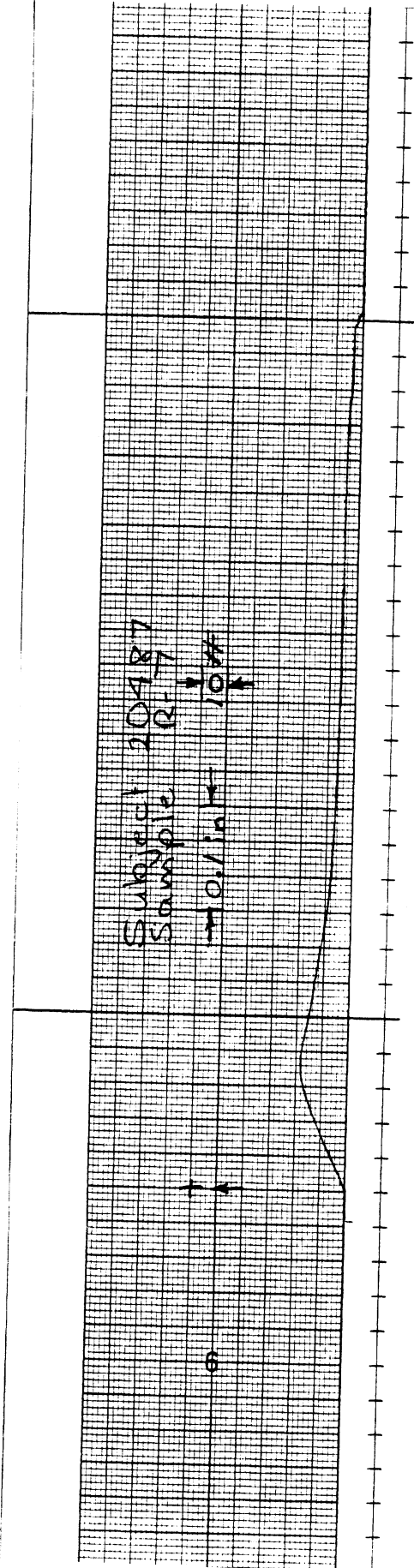
SAMPLE R

MO. INK

10W

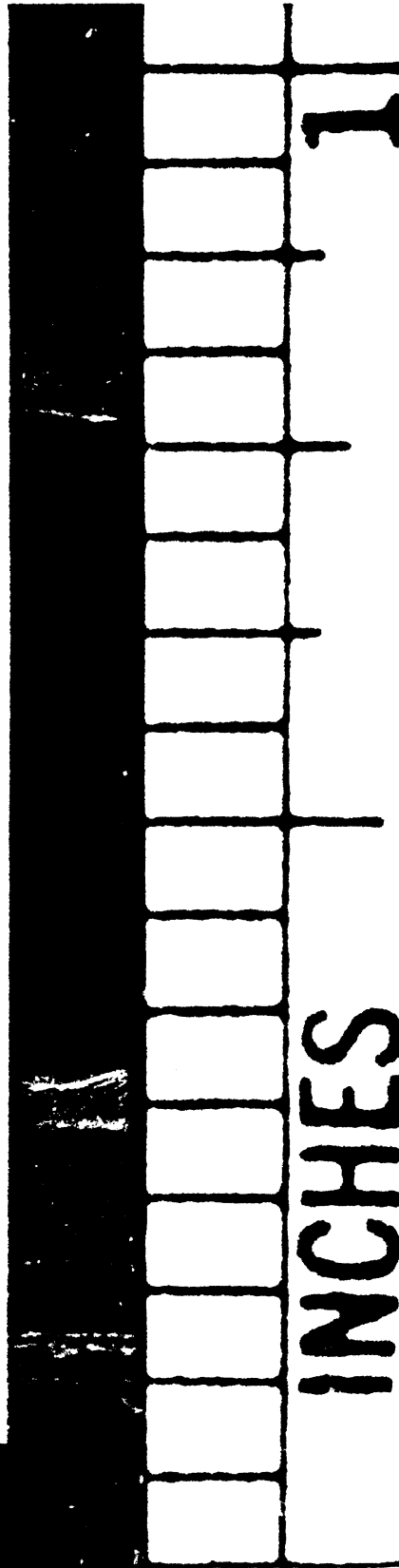
1

6





20487 R7



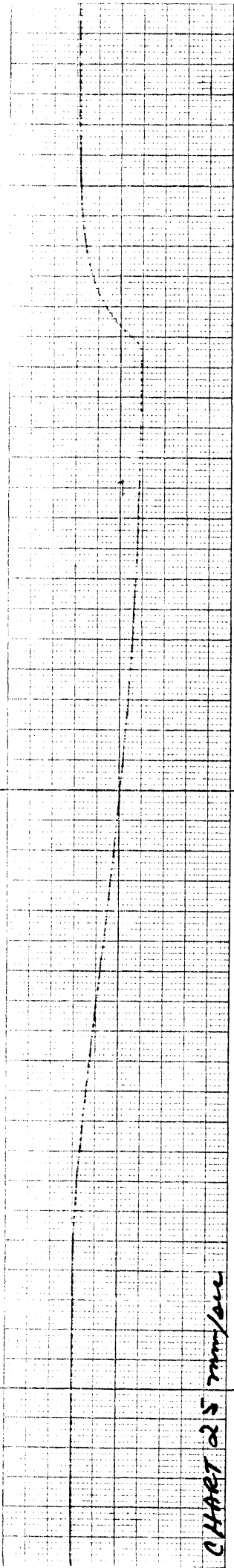
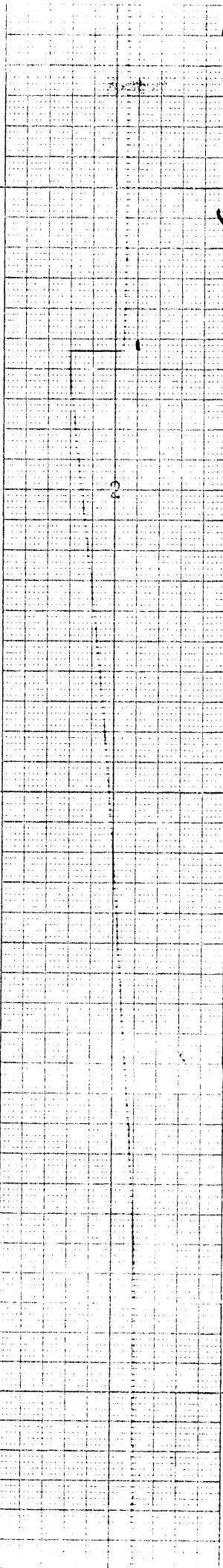


CHART 25 mm/sec

CROSSHEAD 2 cm/min



$\epsilon_{MAX} \approx 1.5\%$

CADAWER - 20487

JUNE 23, 1976

3 POINT BENDING

$\frac{4FL}{bD^3}$

$\frac{\Delta}{L} \approx 4\%$

R. C. Culver

T. Abdelmonem

Winnona

0 | 1 | 2 | 3 | 4



20487

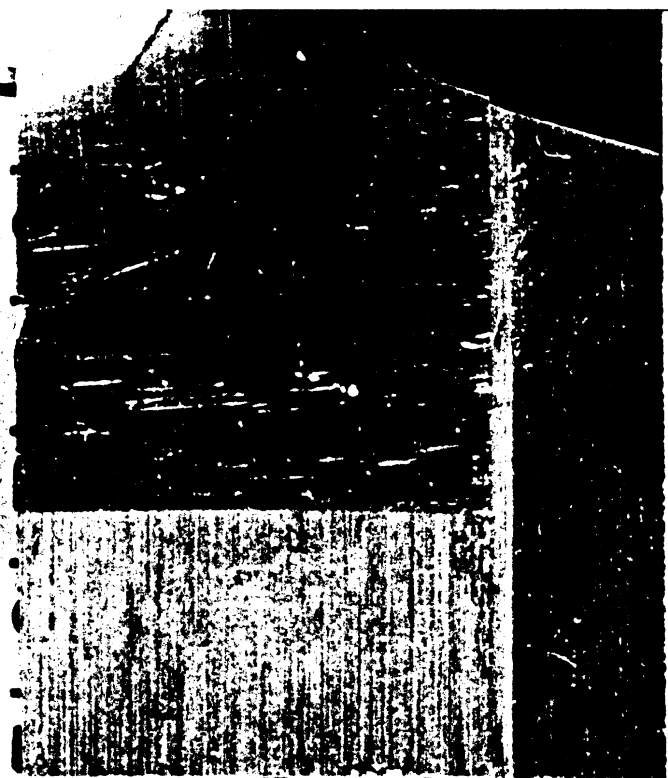
Bending Lt R7

Shannon

0

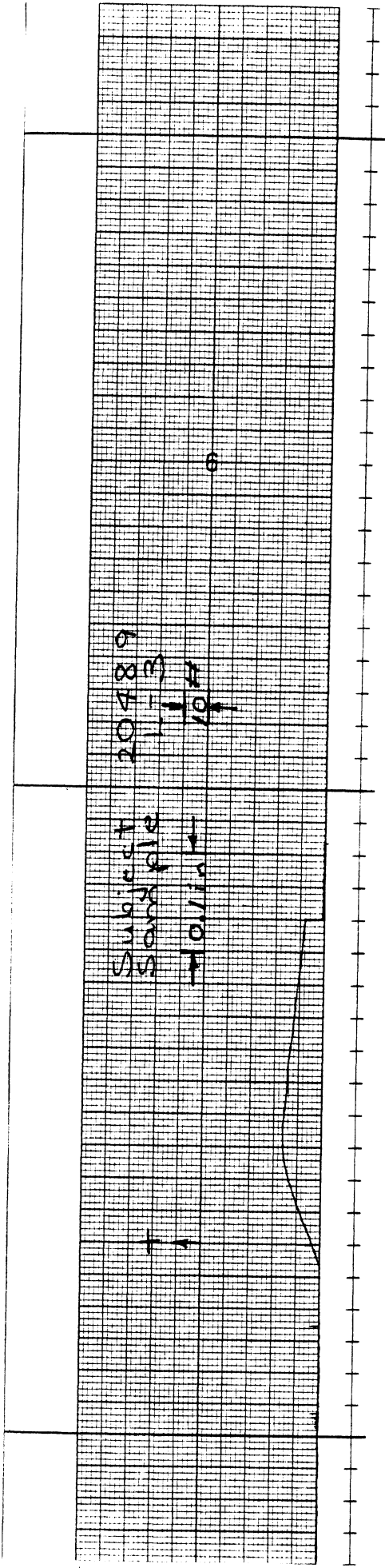
1 | 2 | 3 | 4 |

1



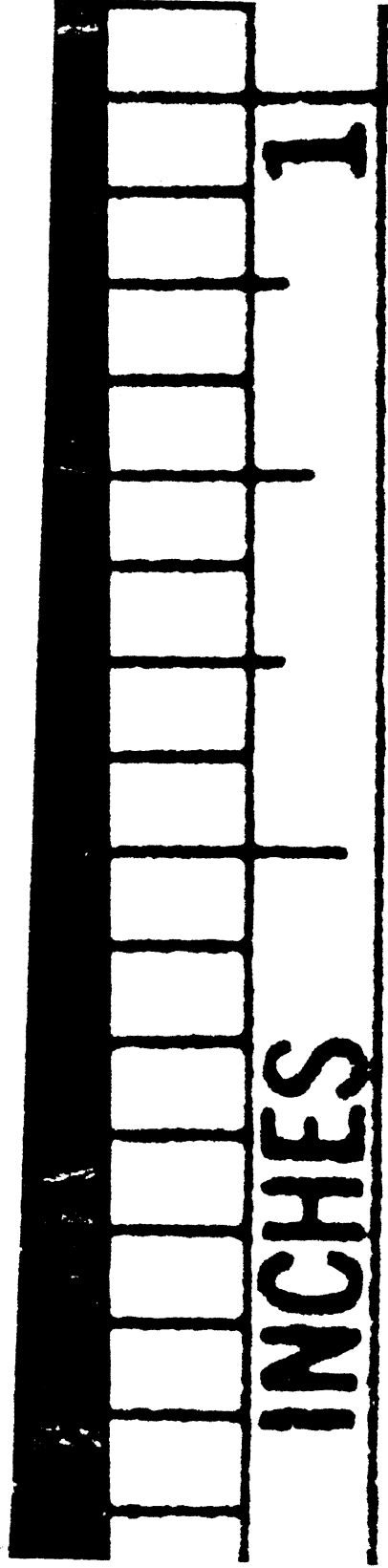
20487

Torsion Lt R8



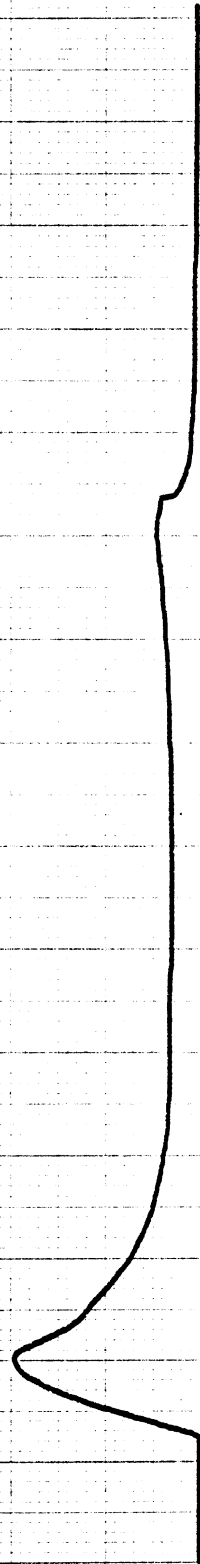


20489 LB



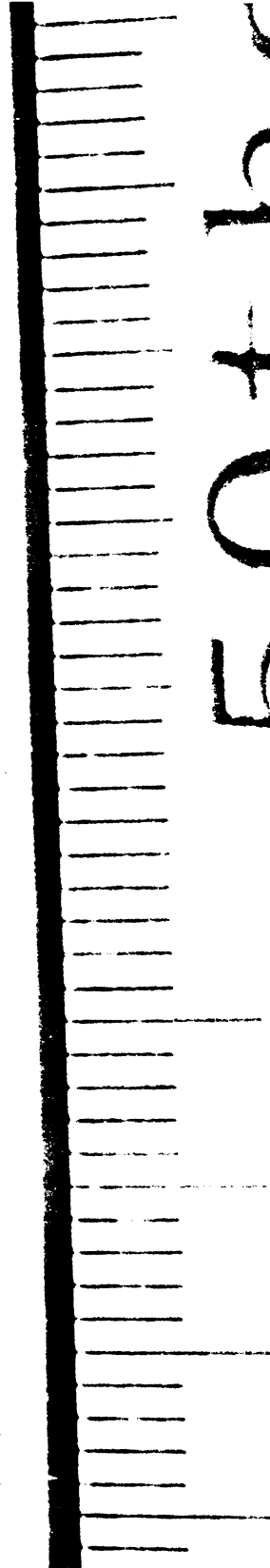
Subject 20494
Sample L7
1/3 inch
10#

+





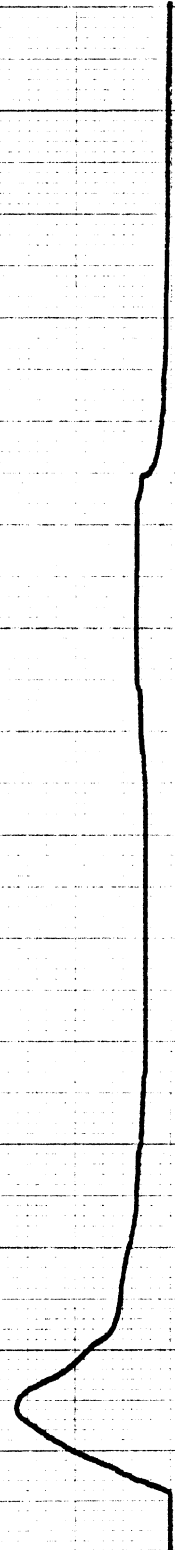
20494117

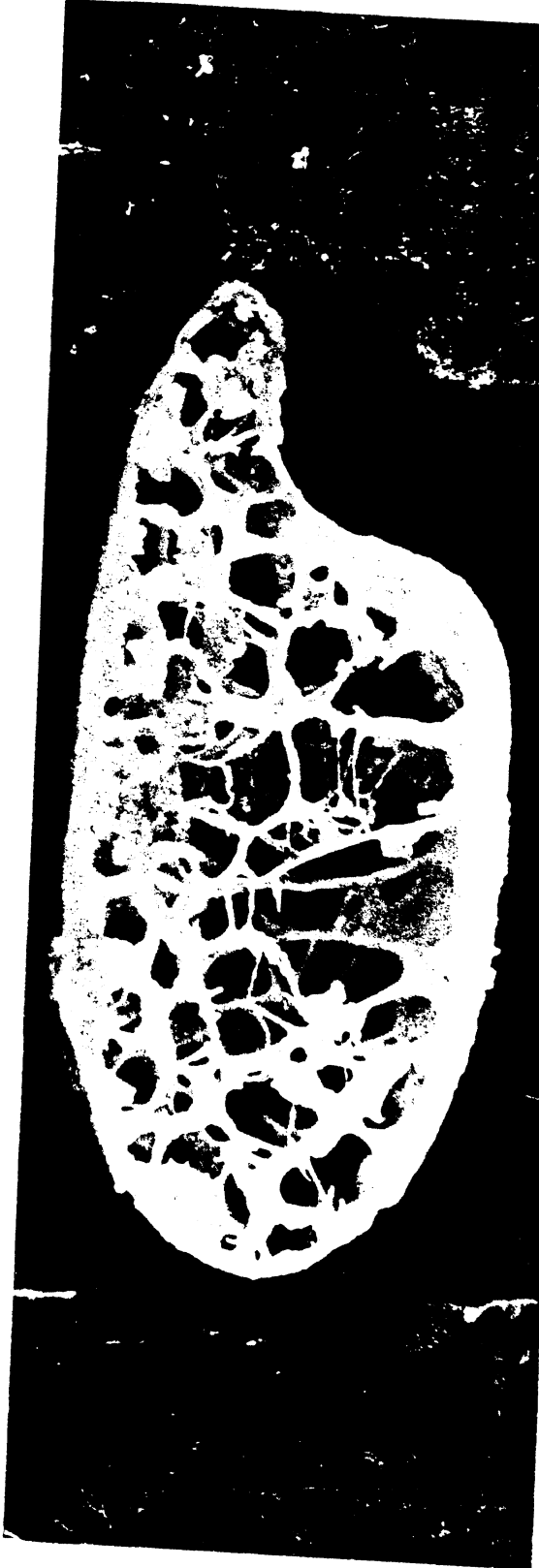


50th

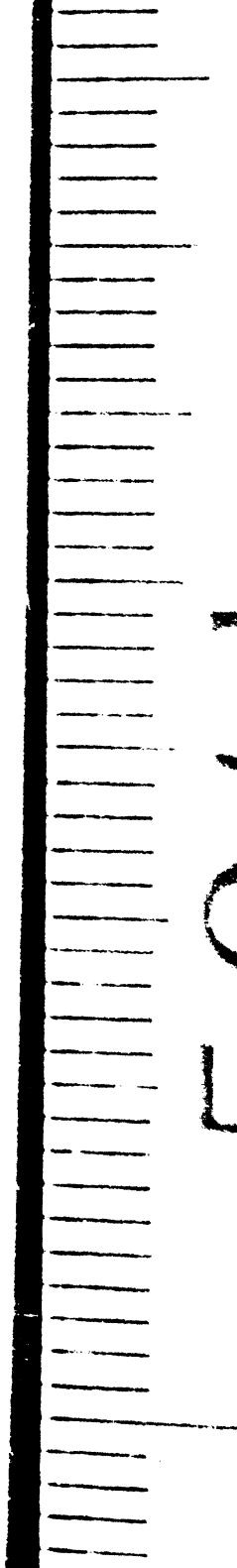
Subject 20494
Sample 48
10#
1/3 inch

+





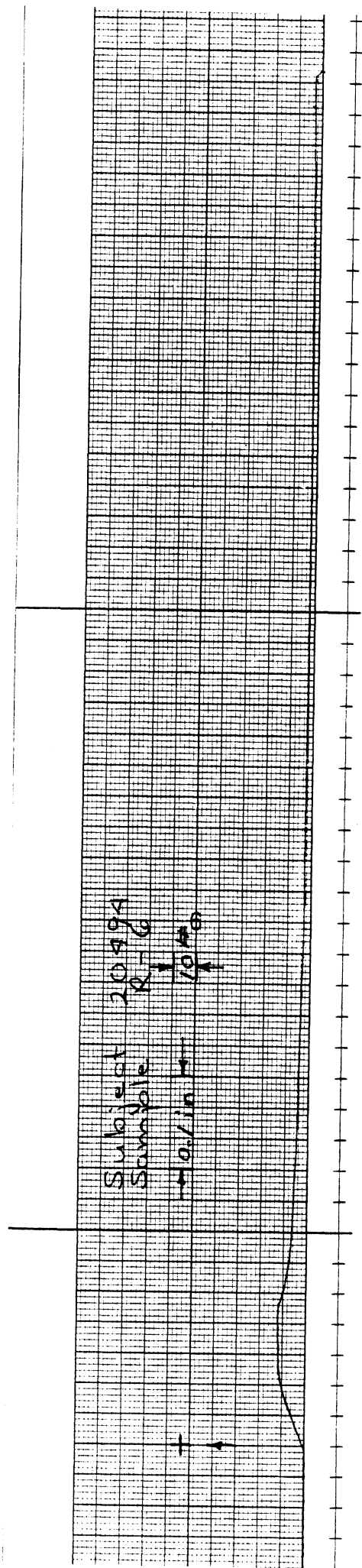
20494118

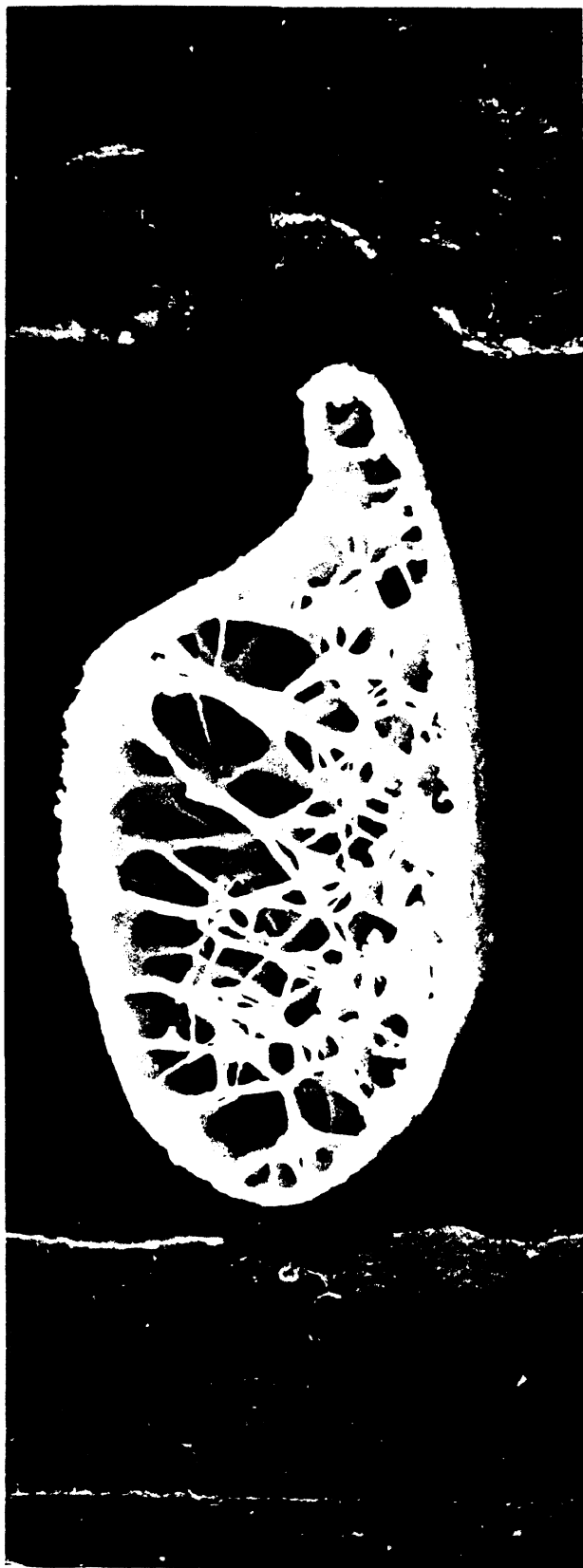


50+ms

Subject 2099A
Sample R-6
10/10/98

T
↑



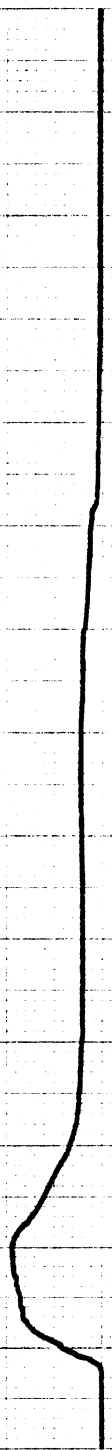


20494 R6



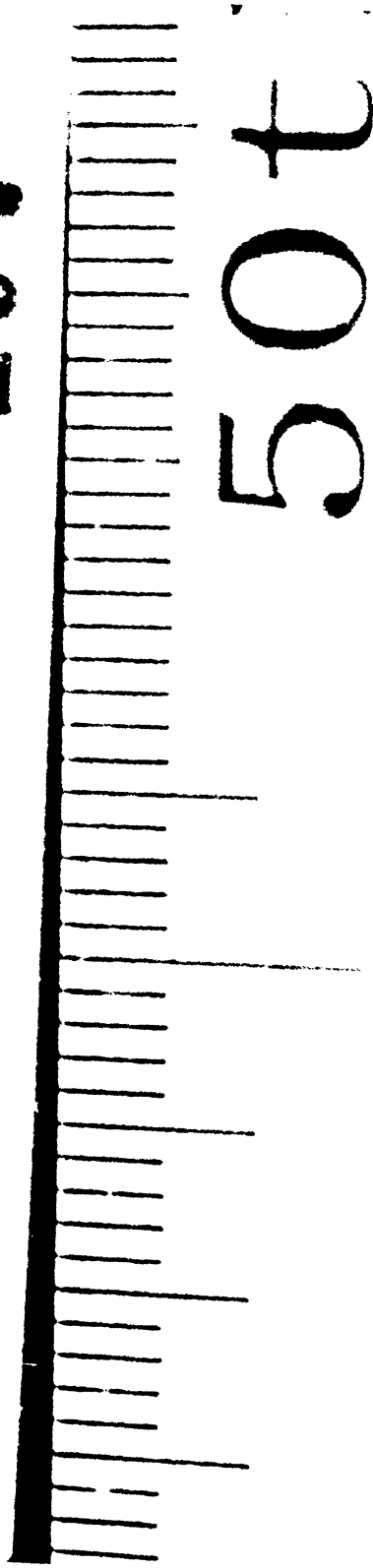
Subject 20494
Sample R7
→ 1/3 inch ←
→ 10# ←
↑

+ ↑





20494 R7



50t

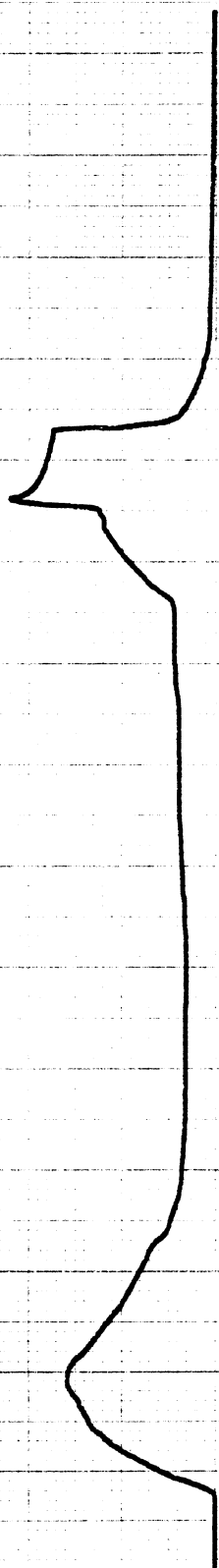
Subject 20494

Sample R 8

→ 1/3 inch ←

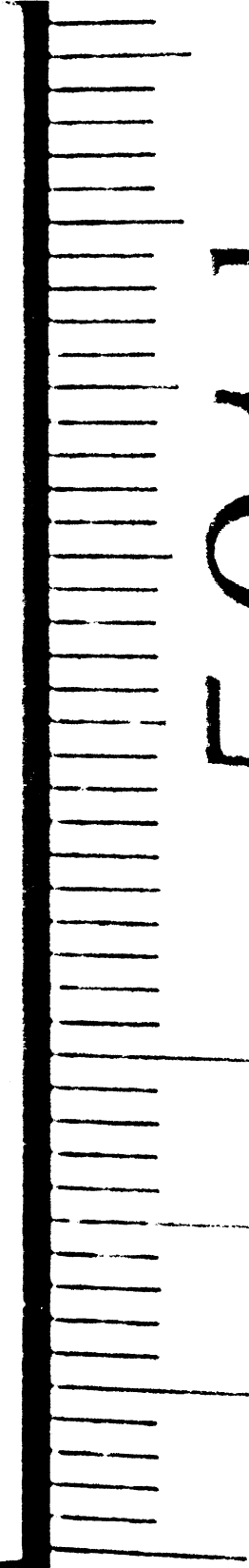
↓ 10# ↓

+ ↑





20494 R8



50ths

20494

R9

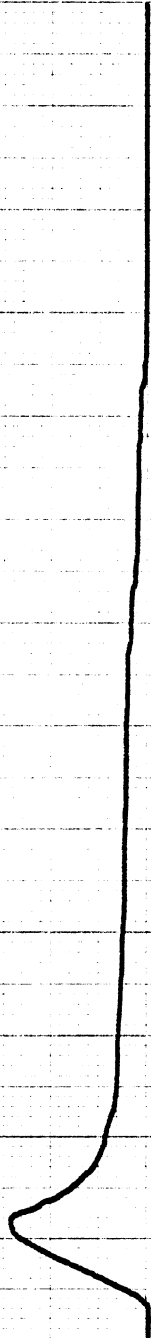
10#

Subject

Sample

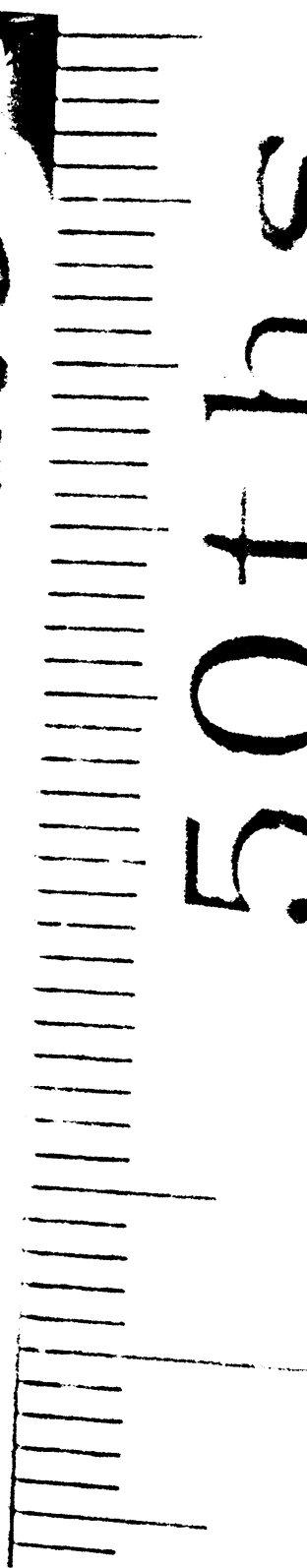
→ 1/3 inch ←

+ →





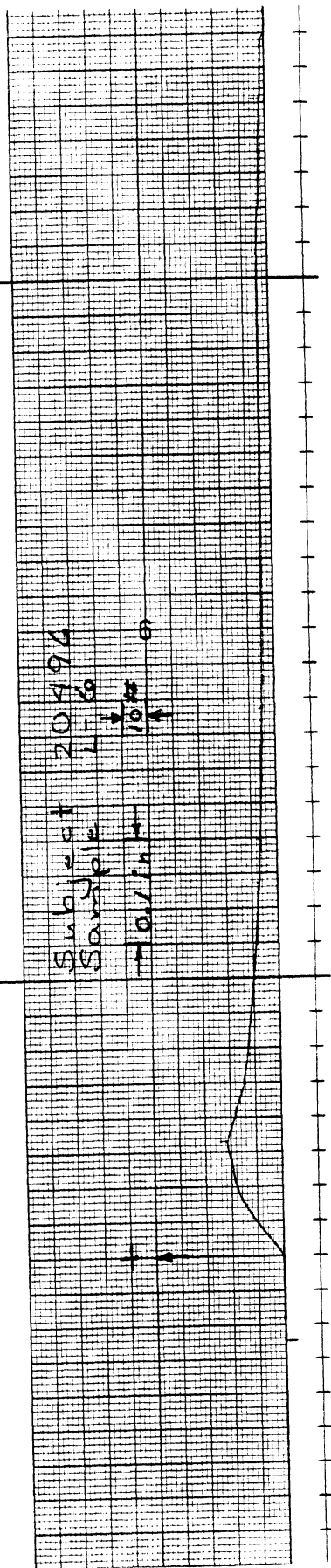
20494 R9

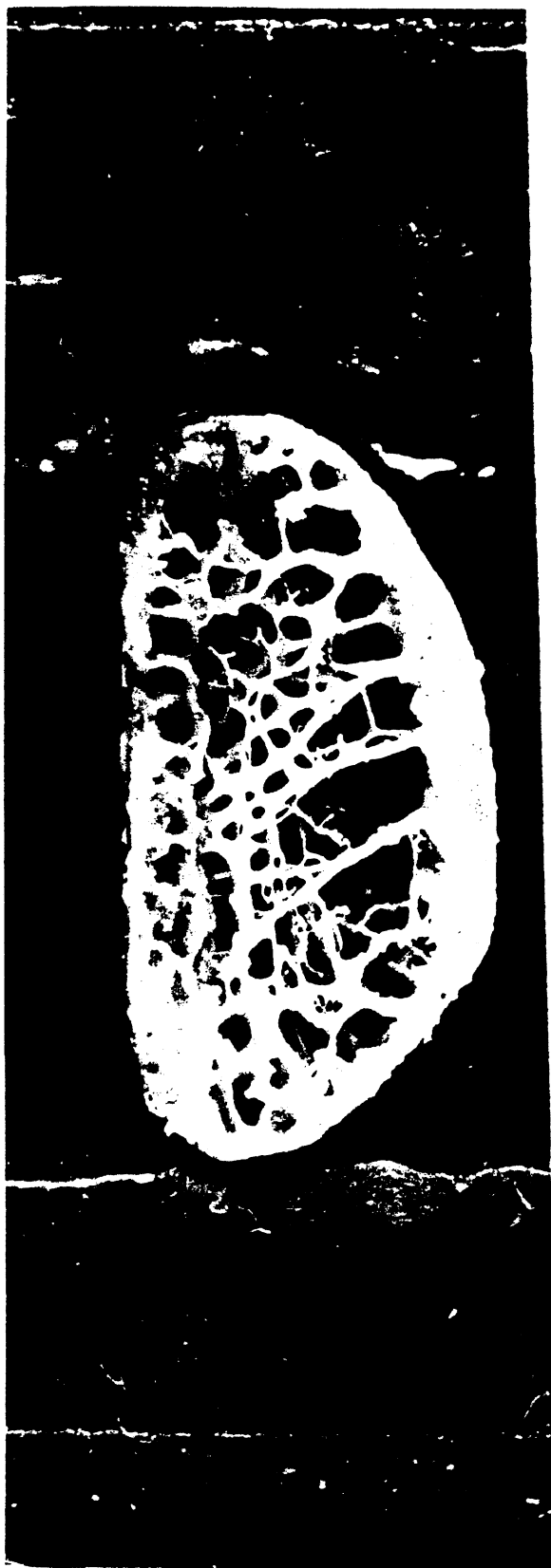


50 t h s

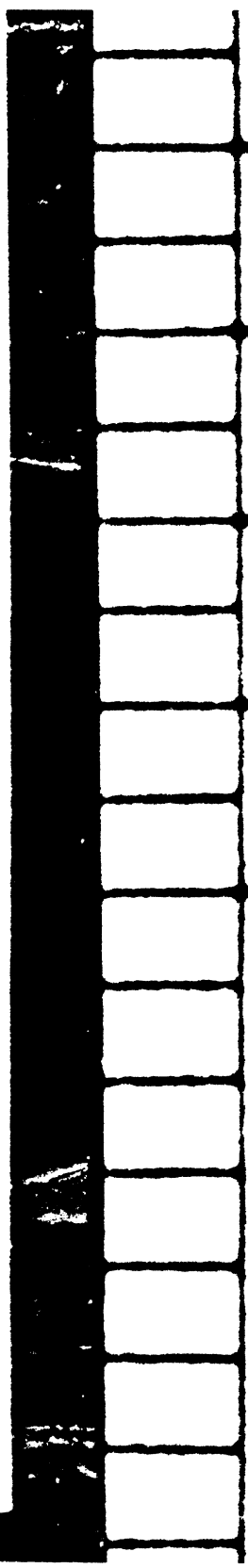
Subject 20496
Sample 1-6
Flowchart

↑





20496 I6

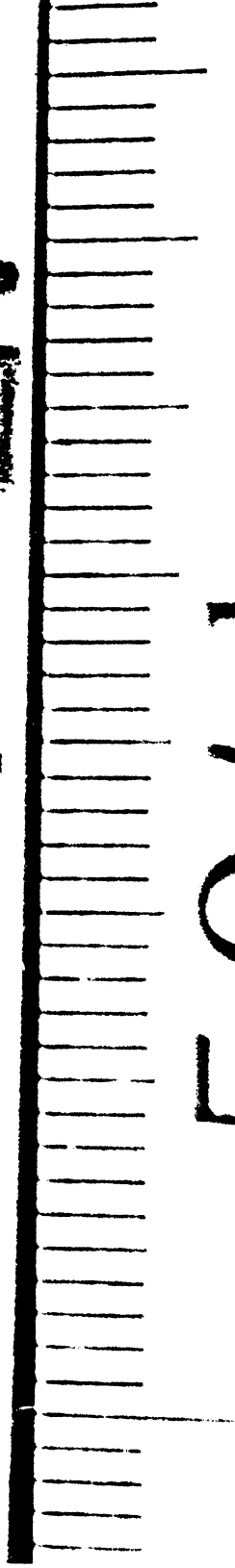


INCHES

1



20496 I17

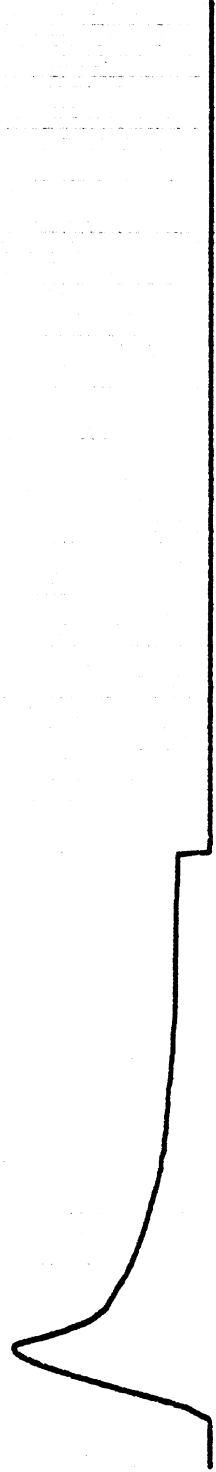


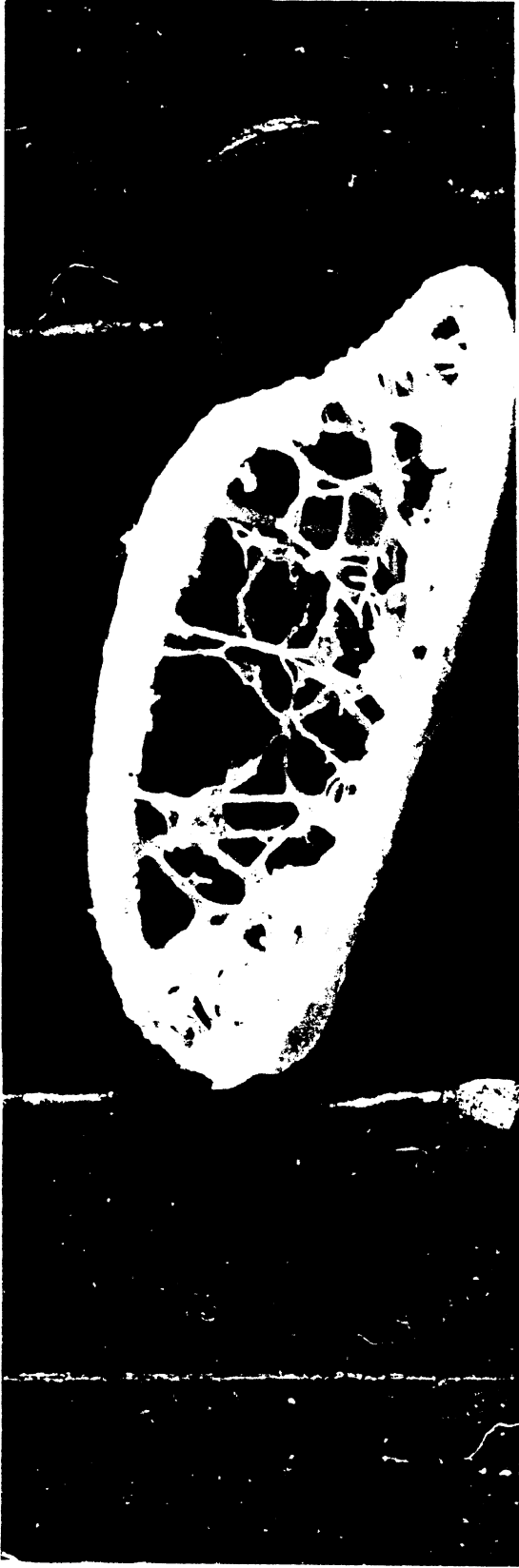
50ths

+ ↑

Subject 20496
Sample L8

→ 1/3 inch ←
10# ↑



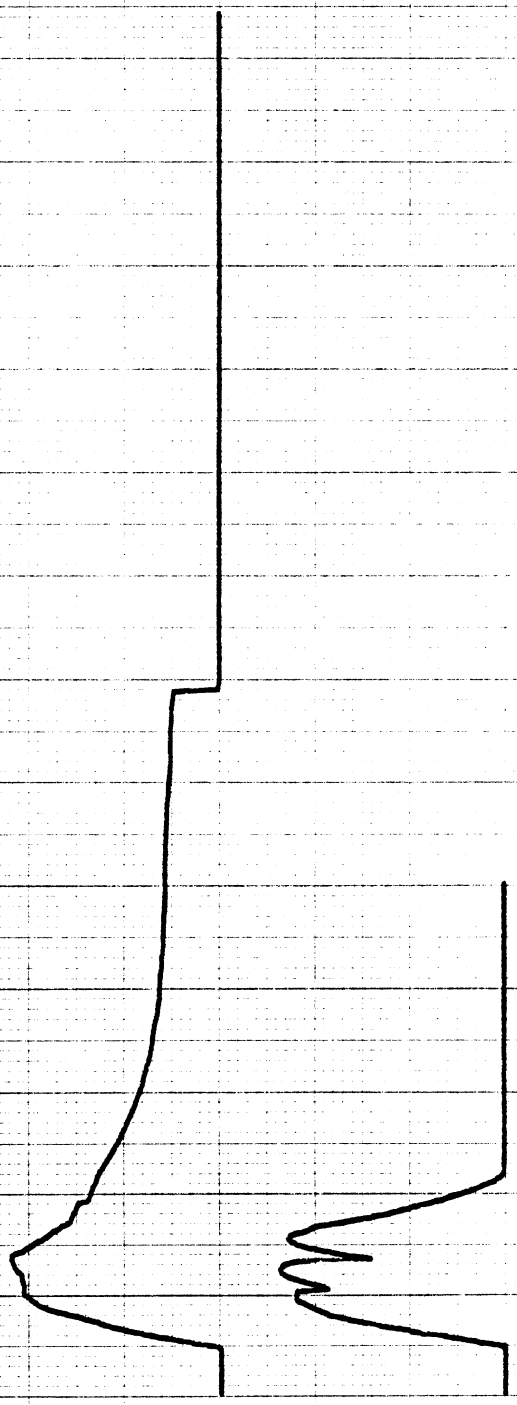


20496 18



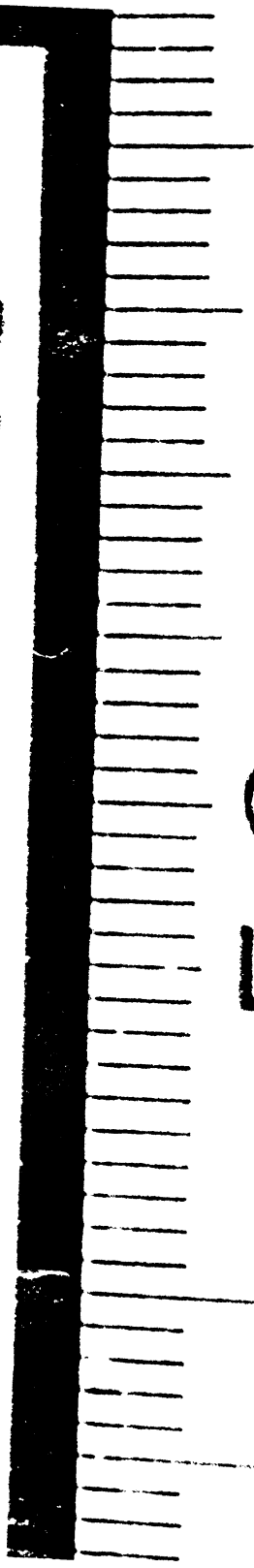
50ths

Subject 20496
Sample R6
1/8 inch
10#

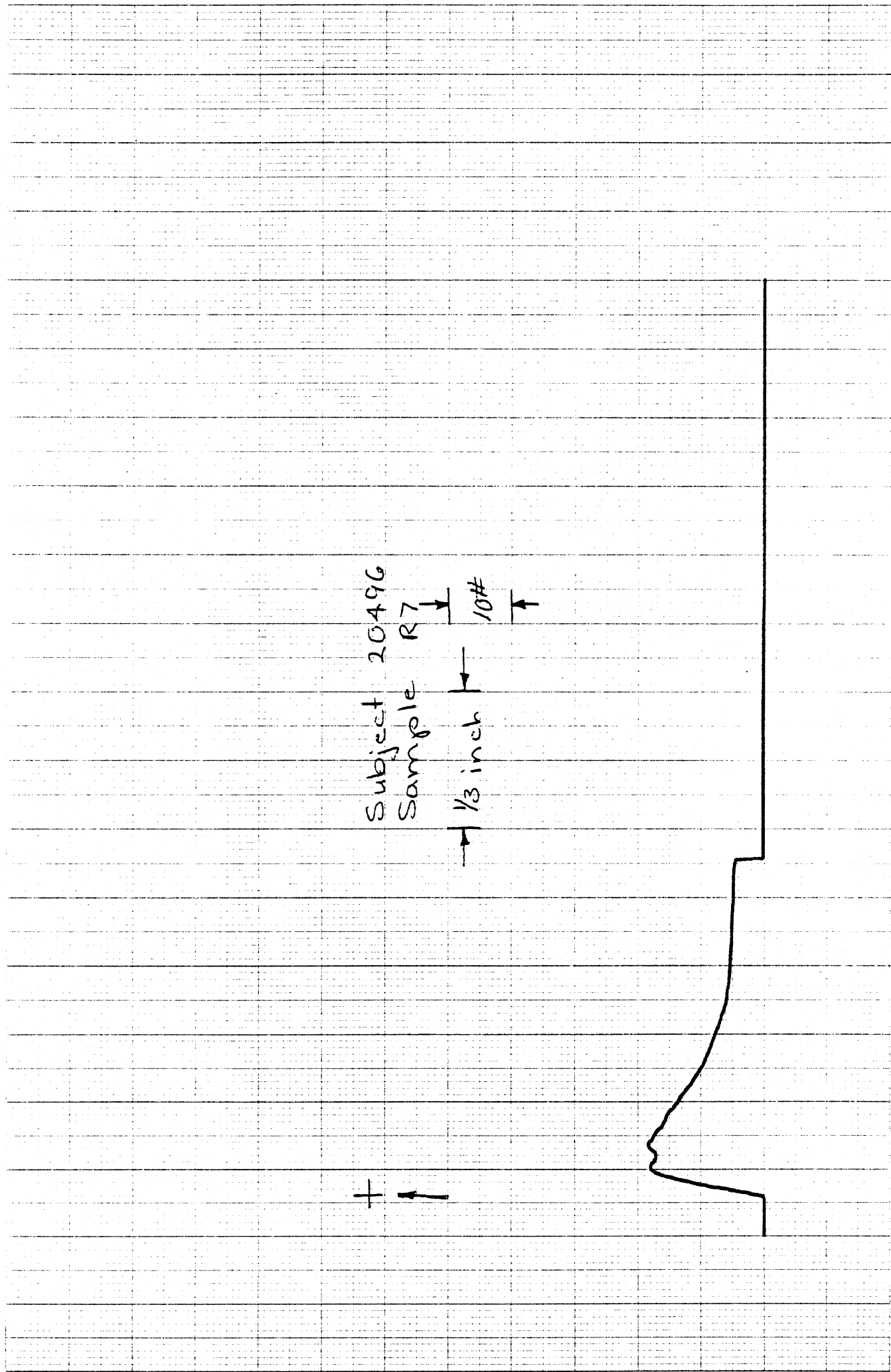




20496 R6

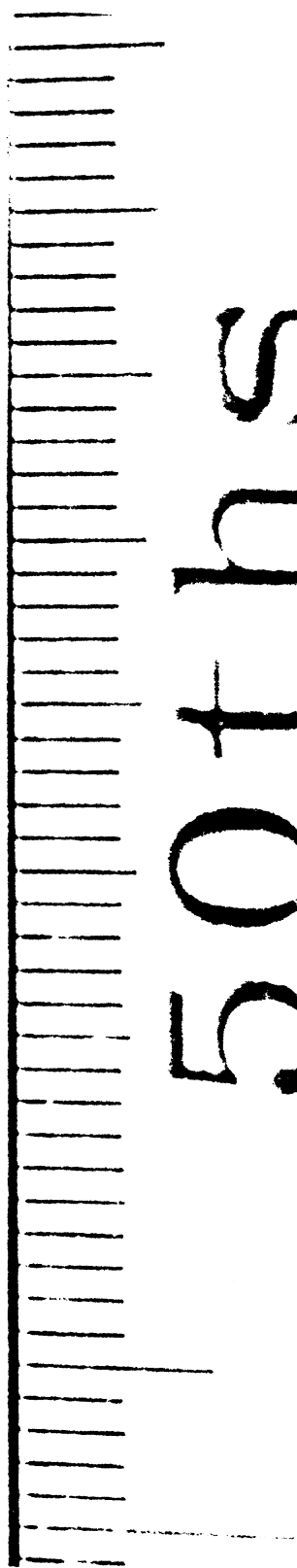


50ths





20496 R7

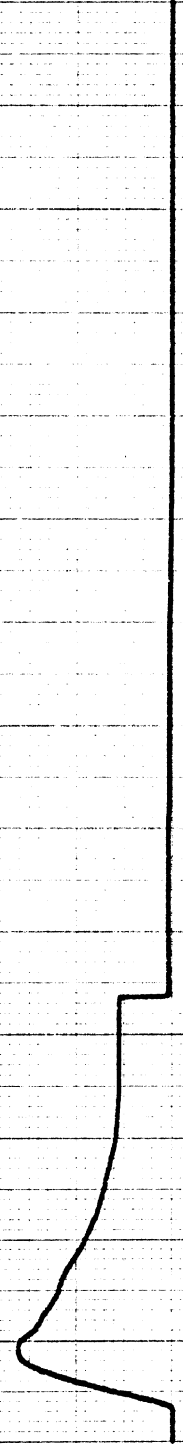


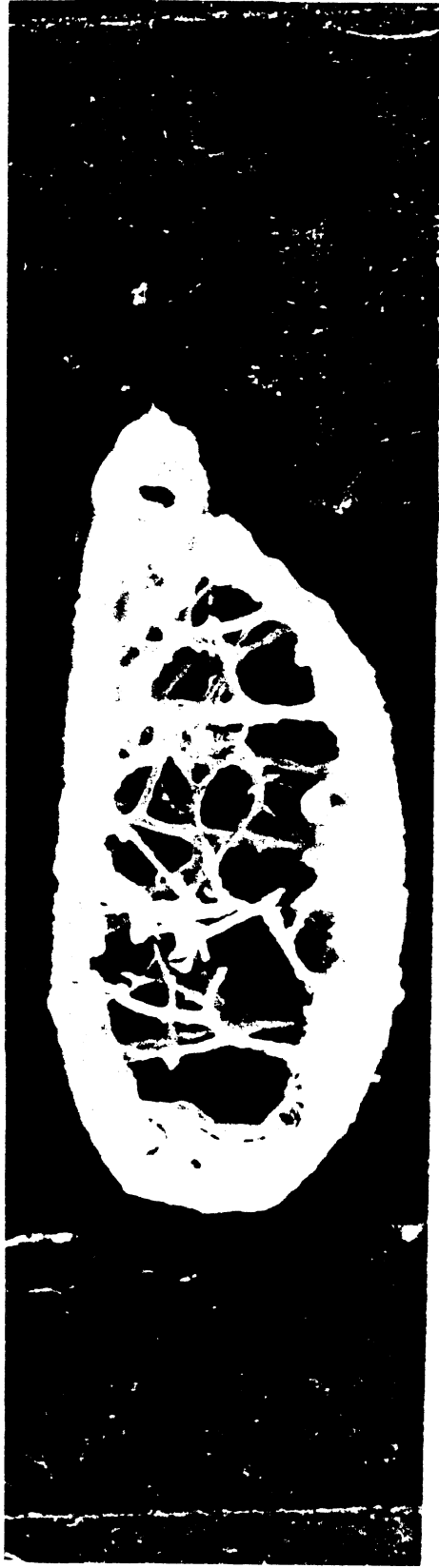
50ths



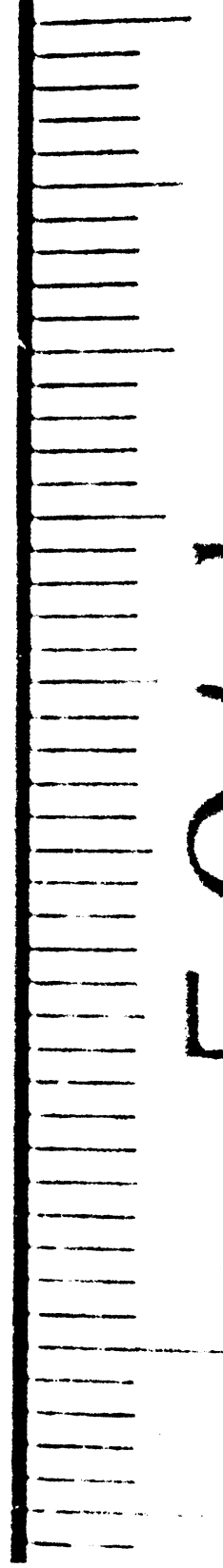
+

Subject 20496
Sample R8
1/3 inch
10#





20496 R8



50ths

+ ↑

Subject
Sample

→ 1/3 inch ←

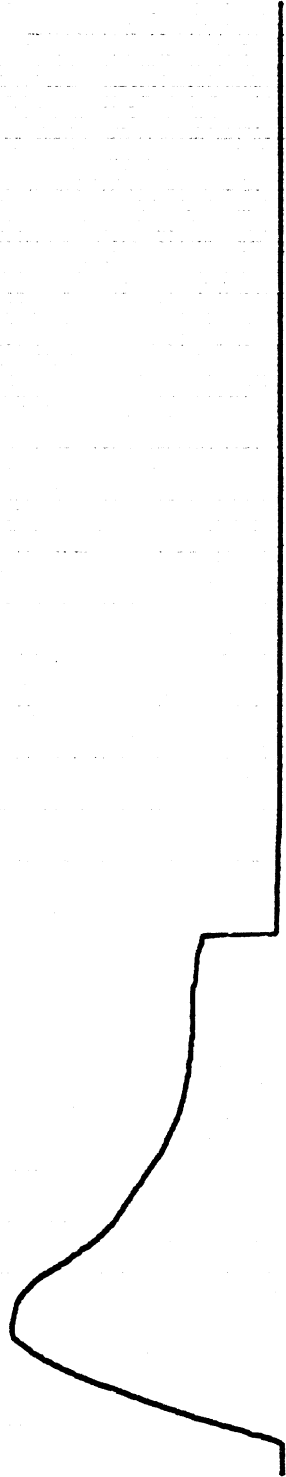
20523

R5

↑

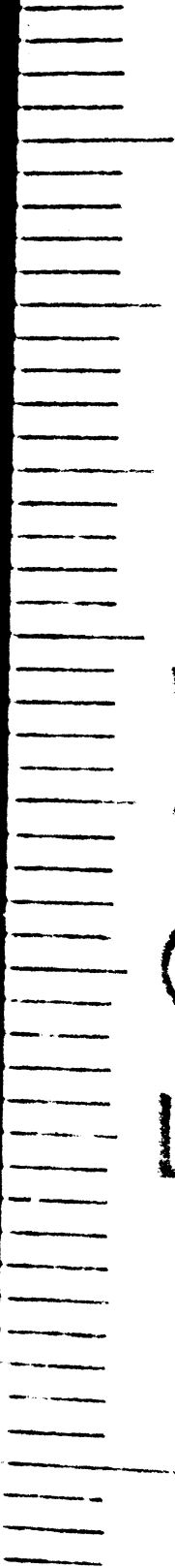
10#

↑





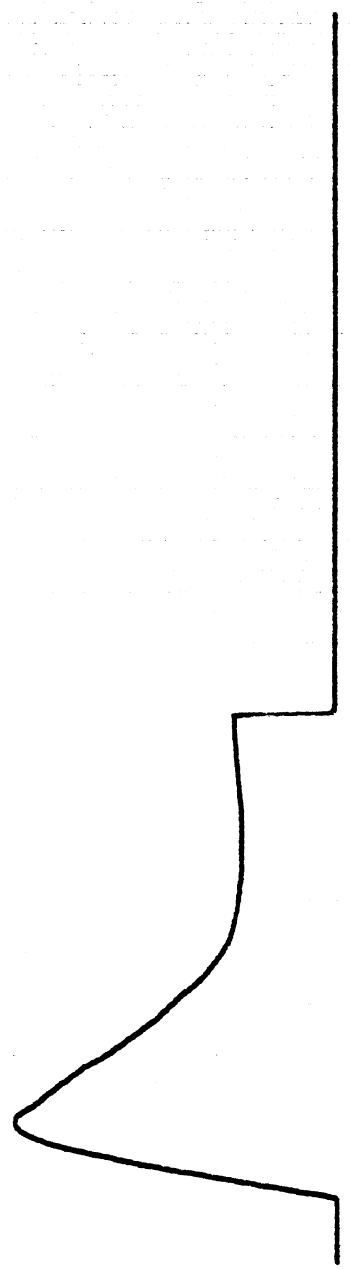
205523 R5

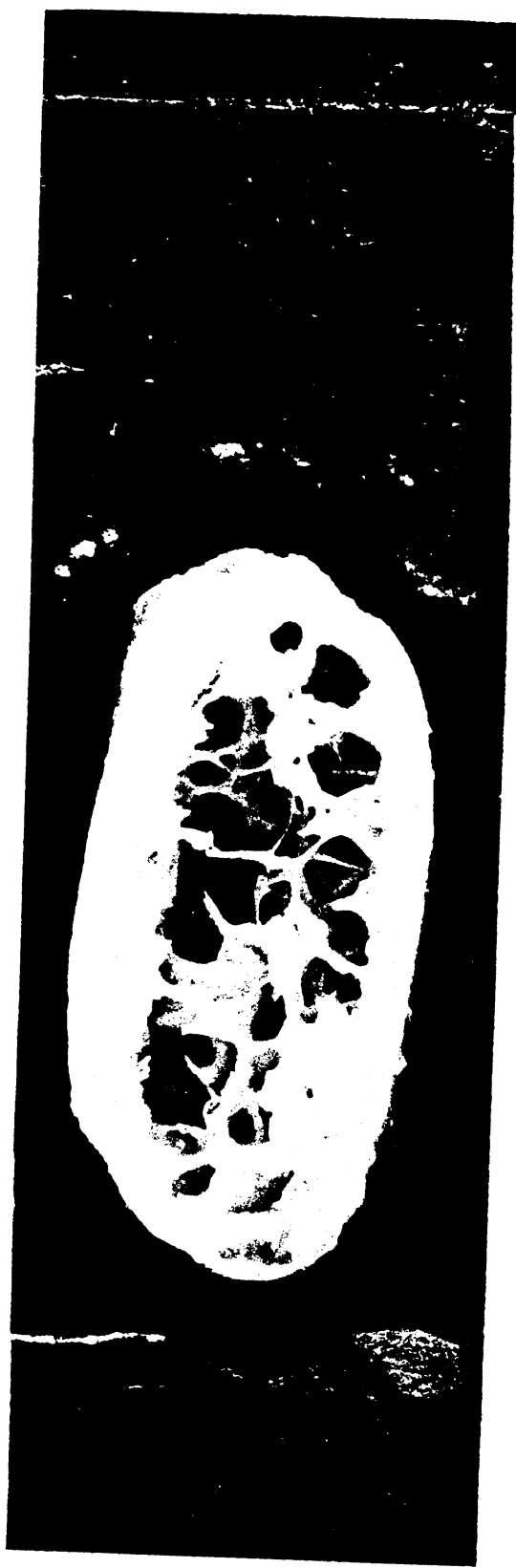


50ths

+ ↑

Subject 20523
Sample RG
→ 1/3 inch ←
← 10# →
↑





20523 R6



50ths

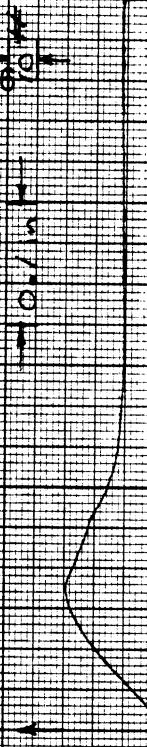
Subject 20523

Sample 2-7

0.01/100

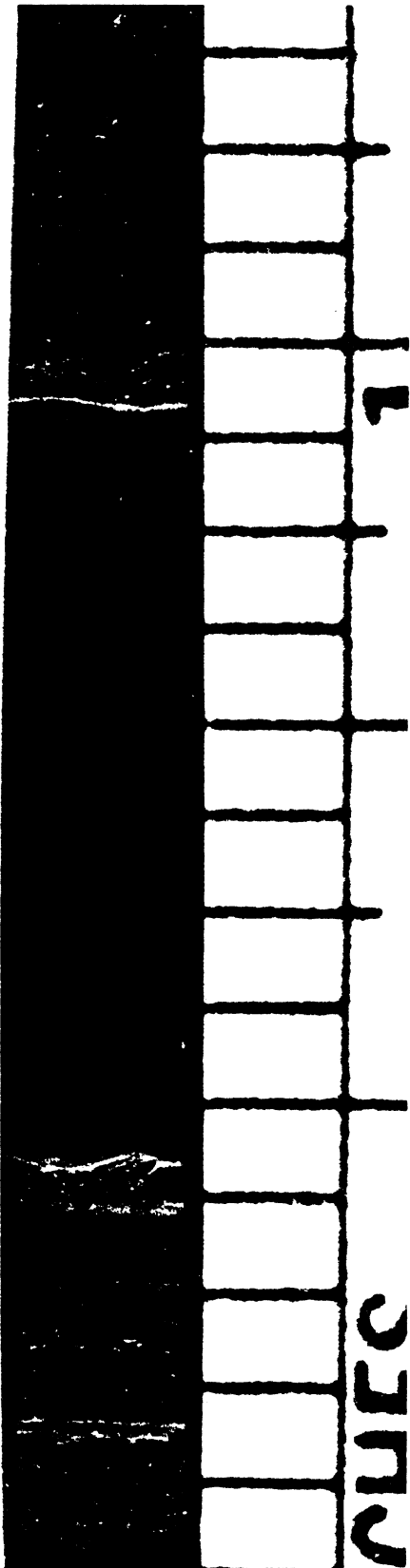
100

+





20523 R7



CM

+ ↑

Subject 20523

R8

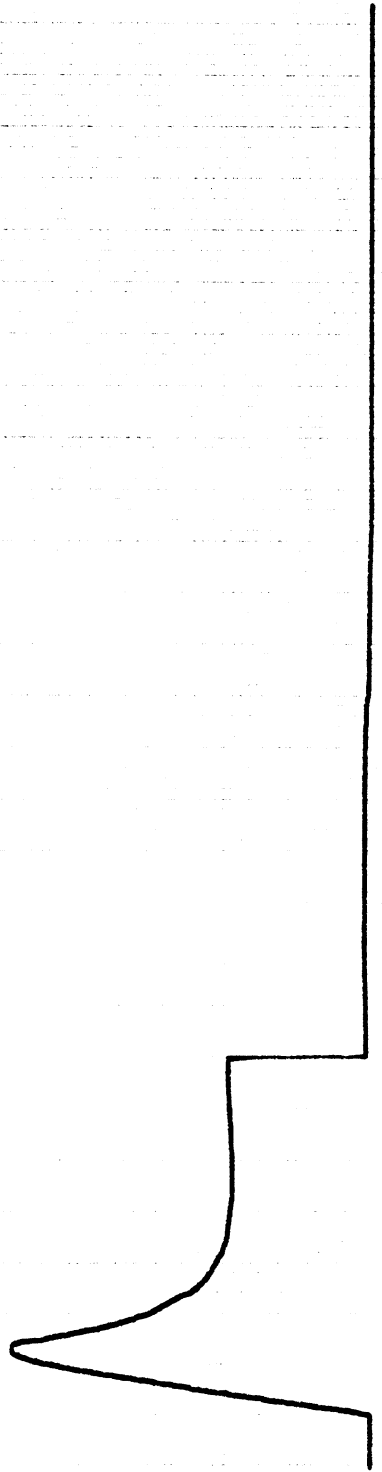


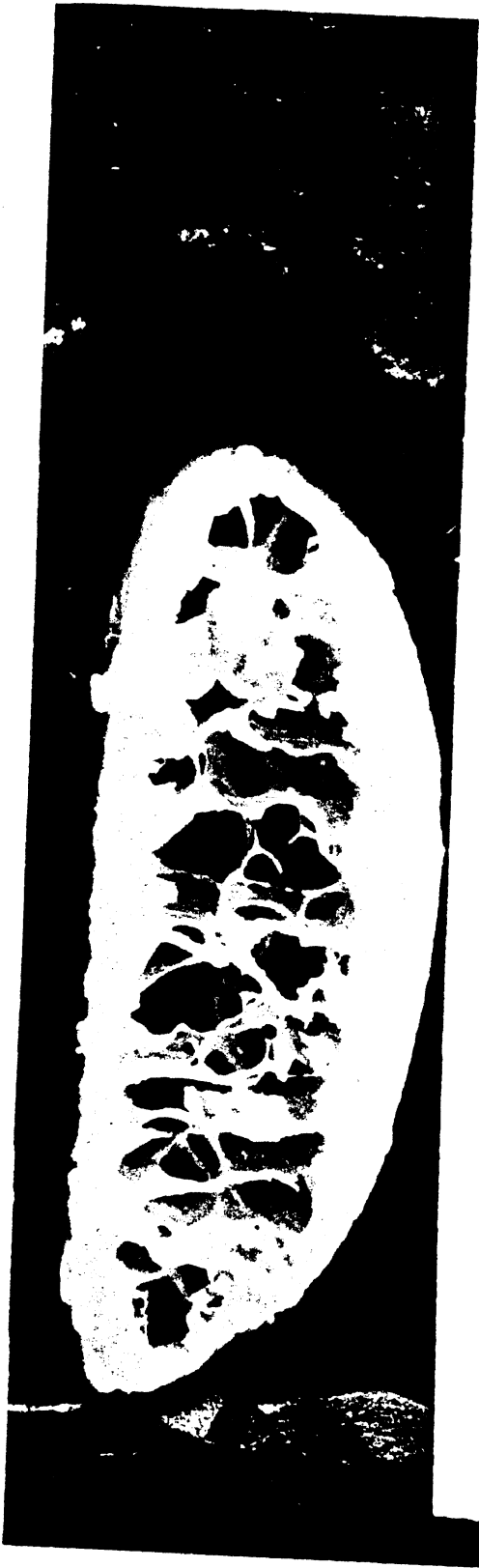
10#



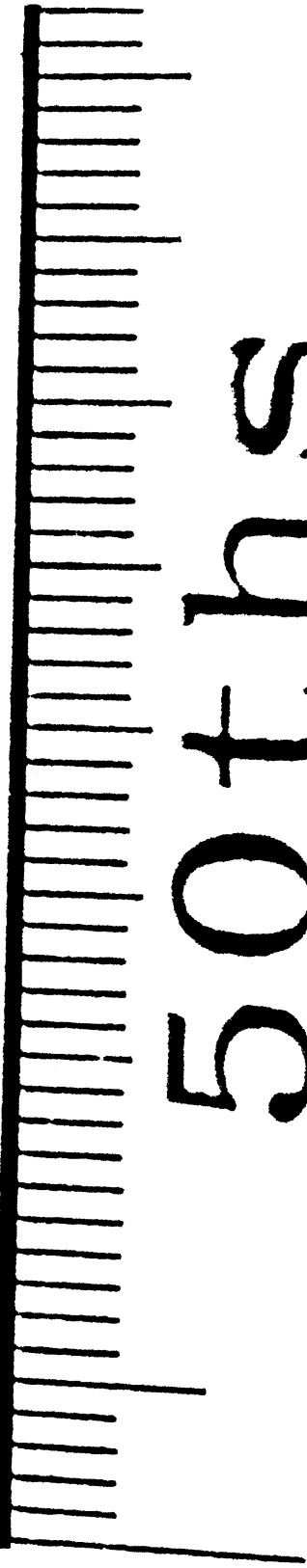
Sample

→ 1/3 inch ←





20523 R8



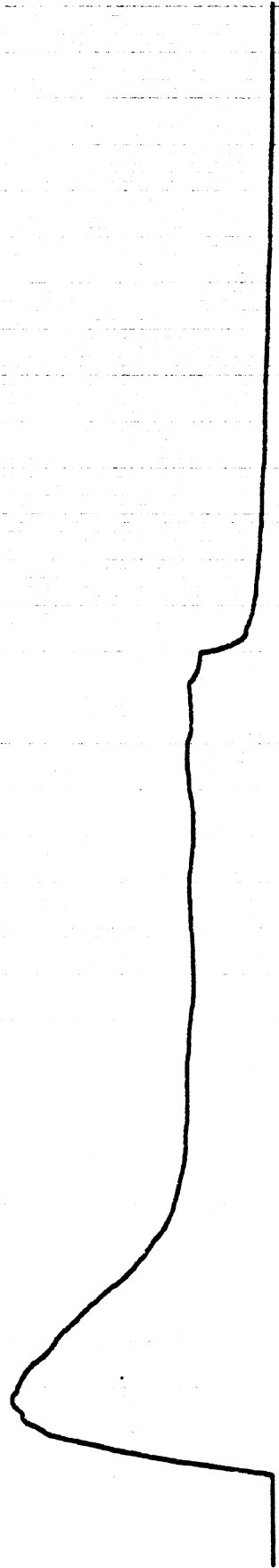
50ths

+ ↑

Subject 20541
Sample L6

→ 1/3 inch ←

↓ 10# ↓

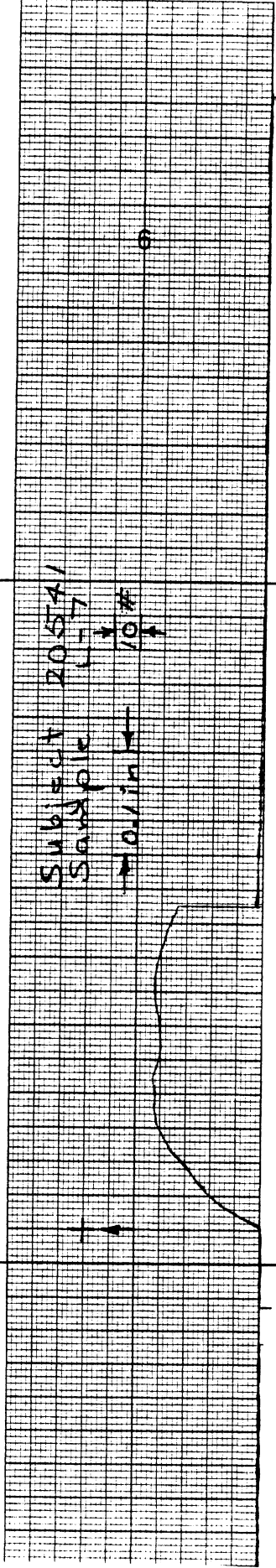




2054116

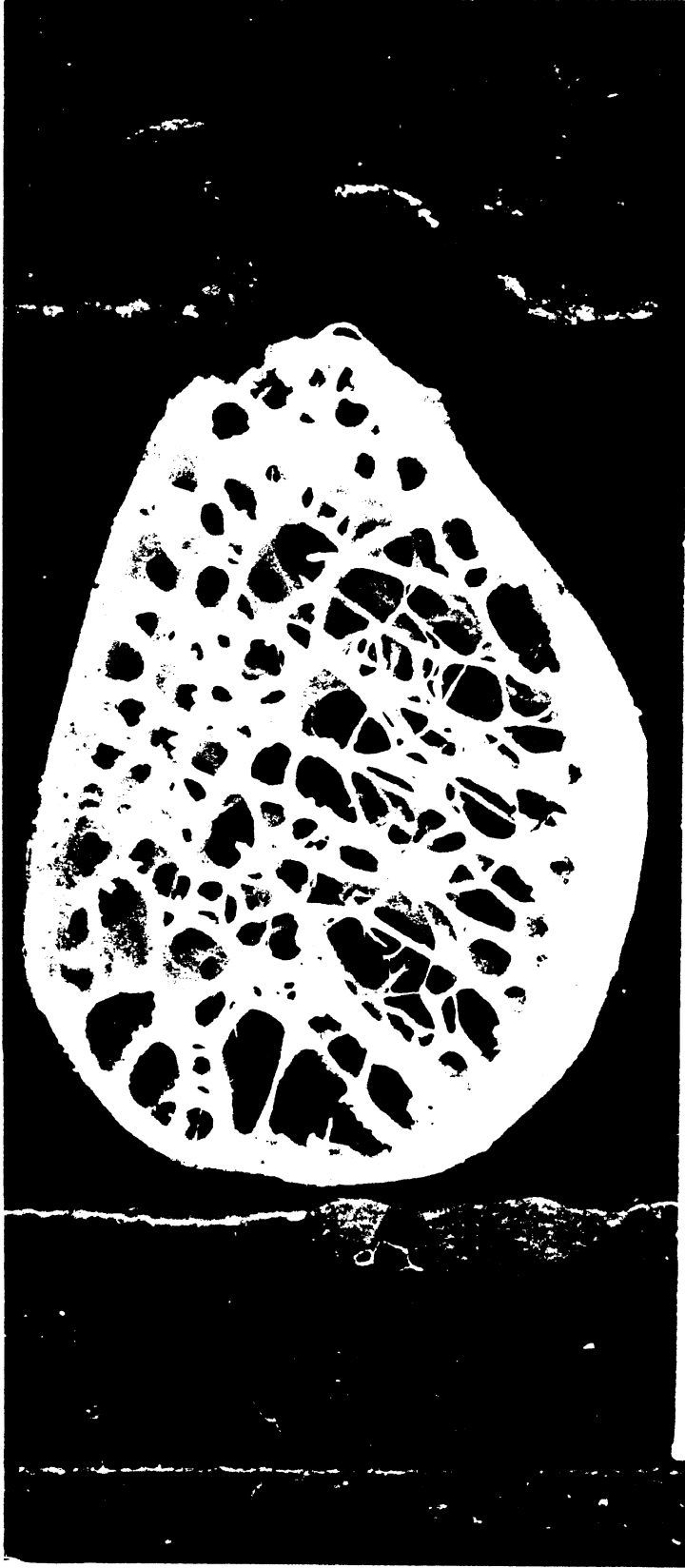


50+ h w



SUBJECT 20541
SAMPLE L-7
10#

S



2054117

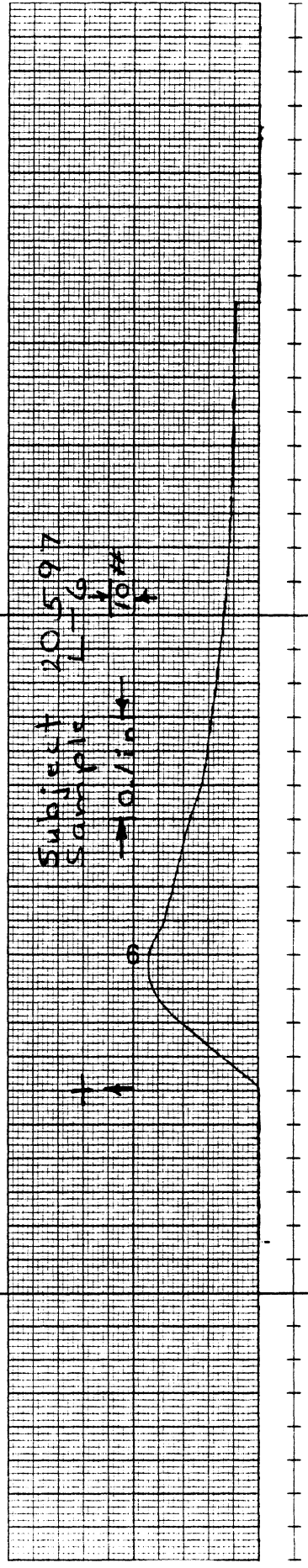


Subject 20597

Sample 1-6

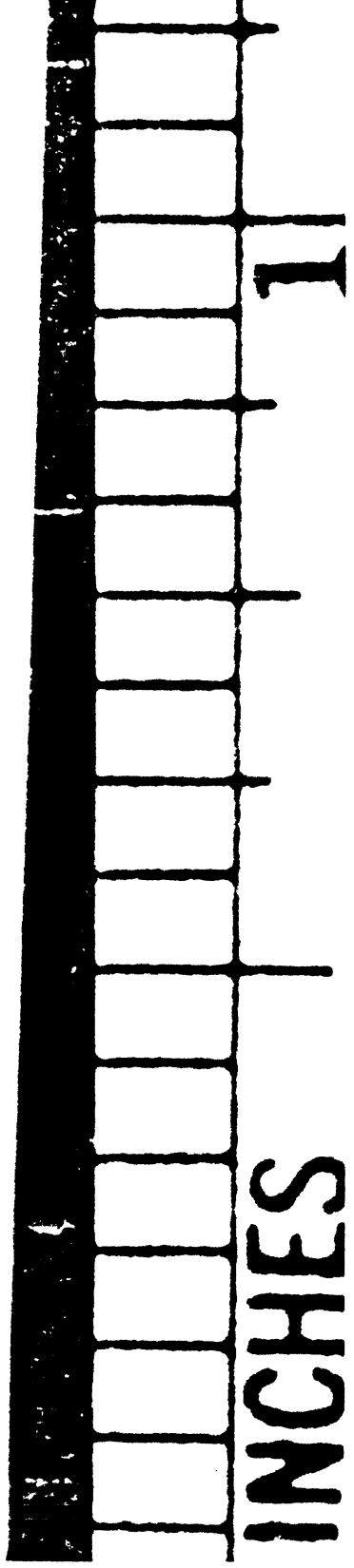
10.11.14

+





20597



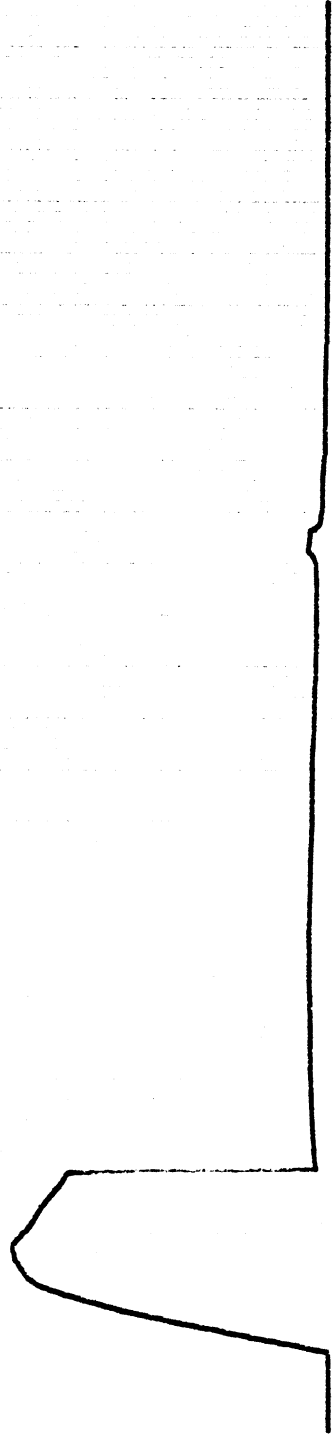
+ ↑

Subject
Sample

→ 1/3 inch ←

20597
L7

↓ 10# ↑





20597 I17



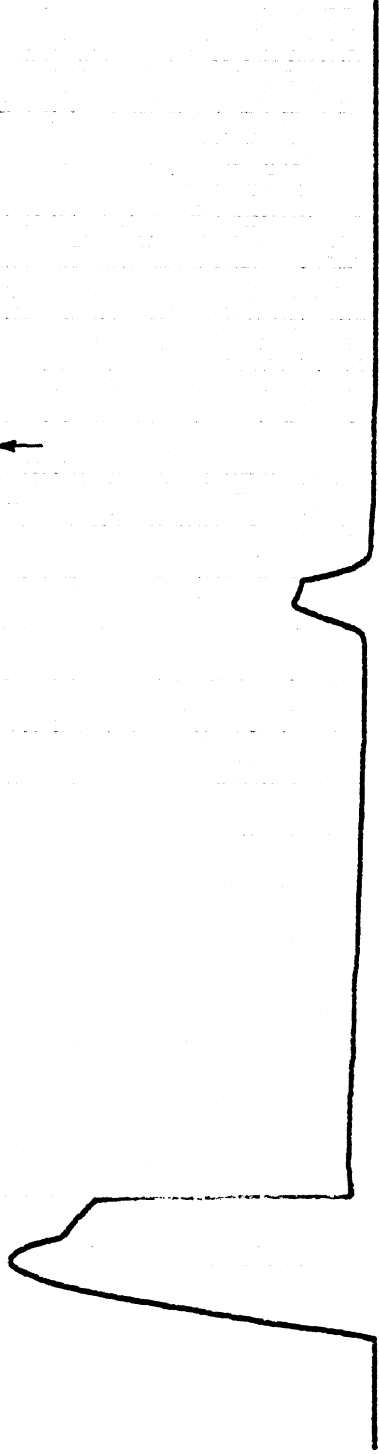
50ths

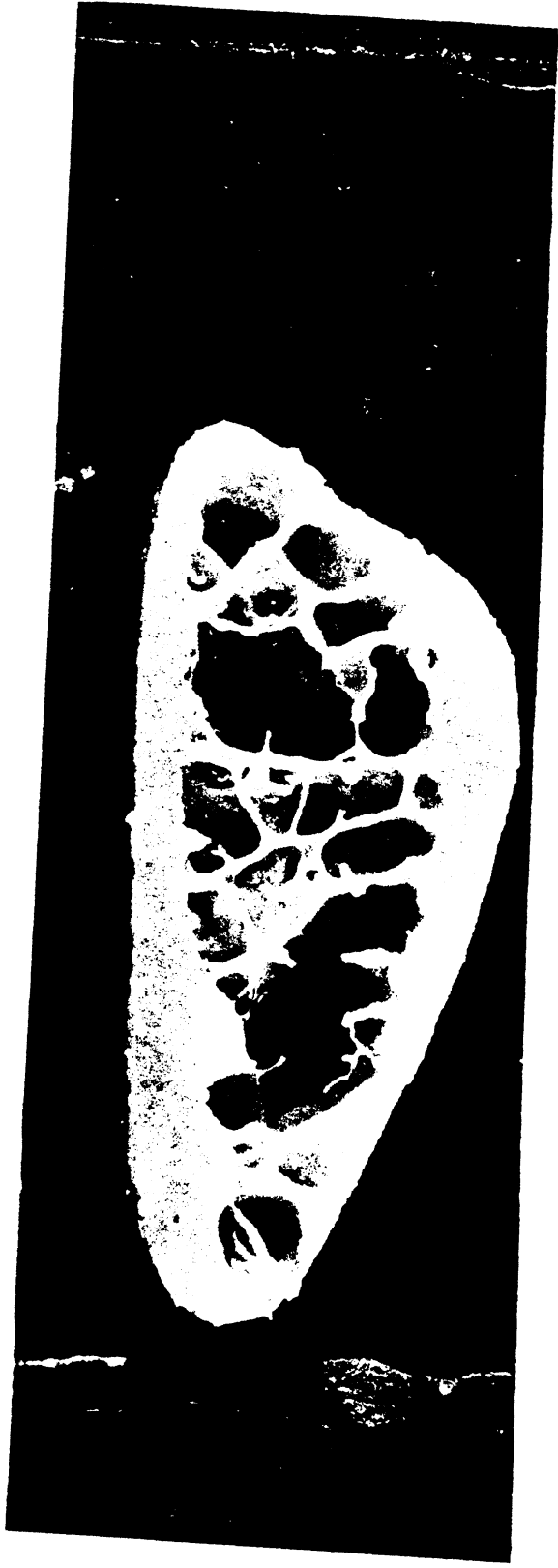
↑

Subject 20597
Sample L8

→ 1/3 inch ←

↓ 10# ↑





20597 L8



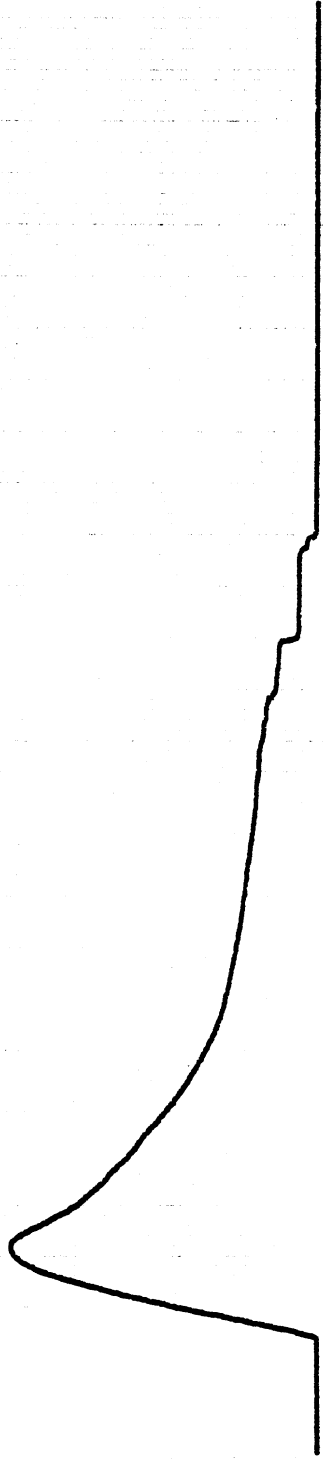
50ths

+ ↑

Subject 20606
Sample R5

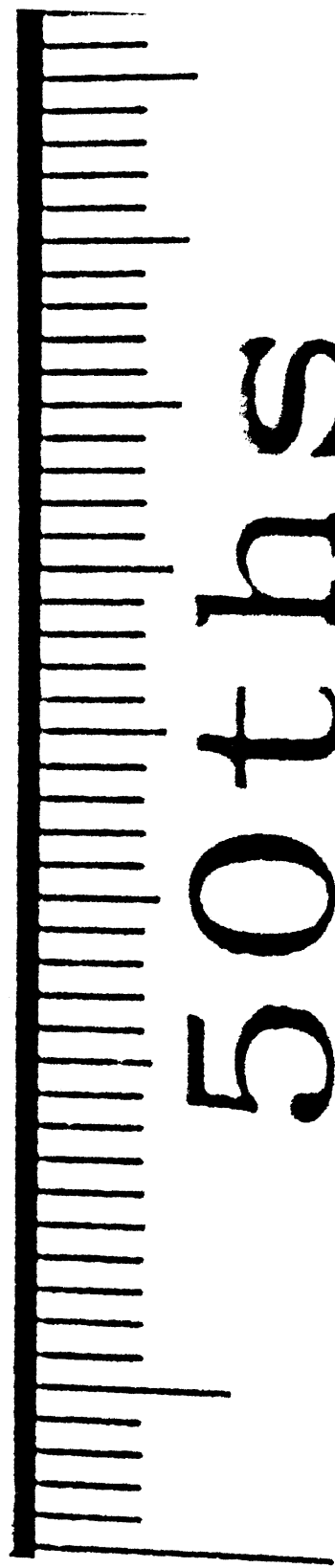
→ 1/3 inch ↓

↓ 10# ↑



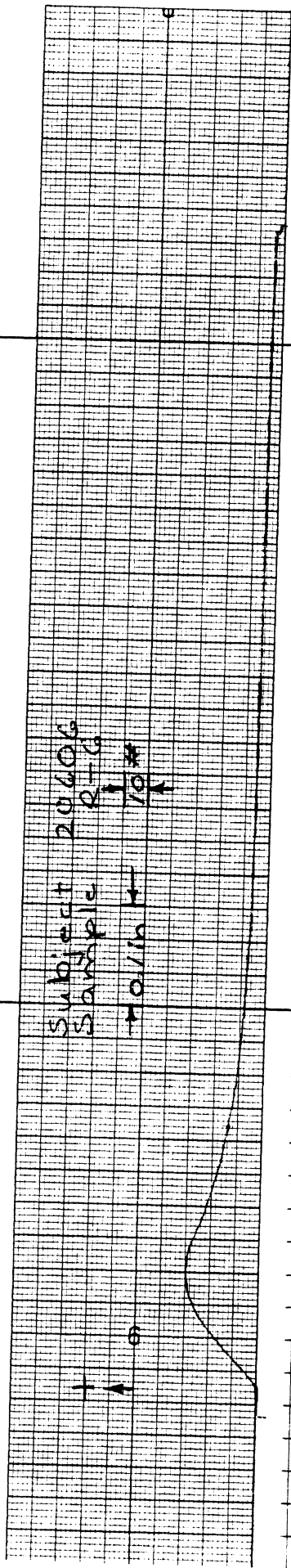


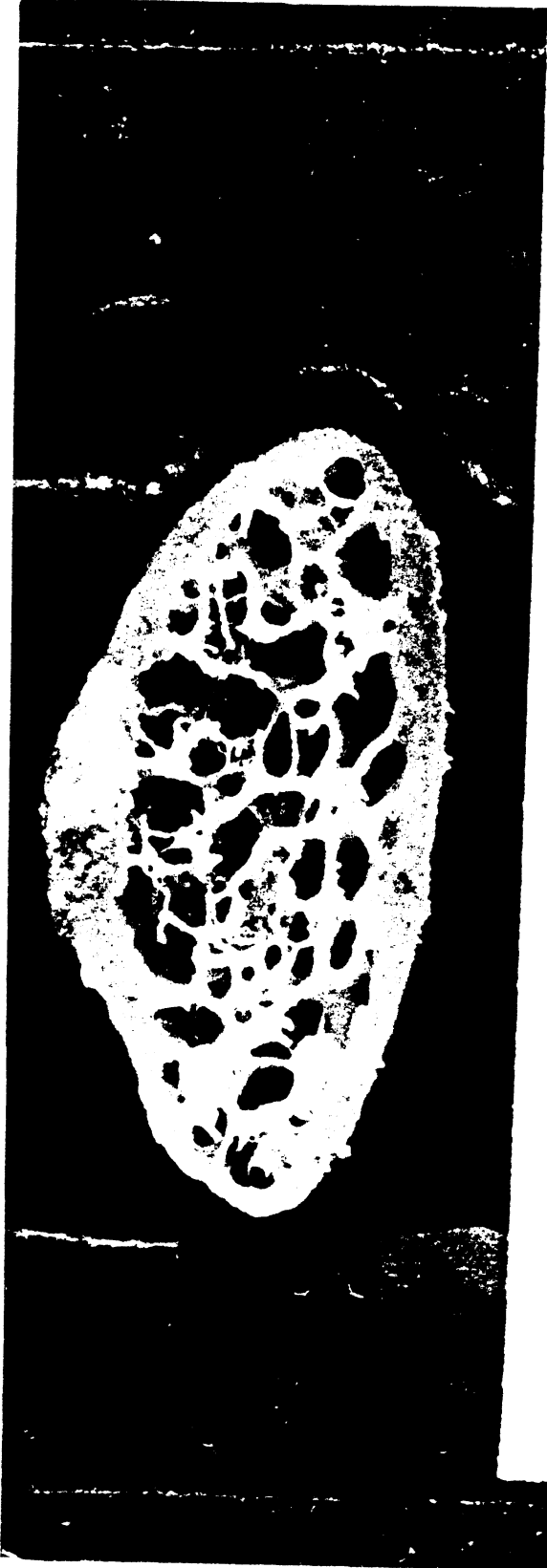
20606 R5



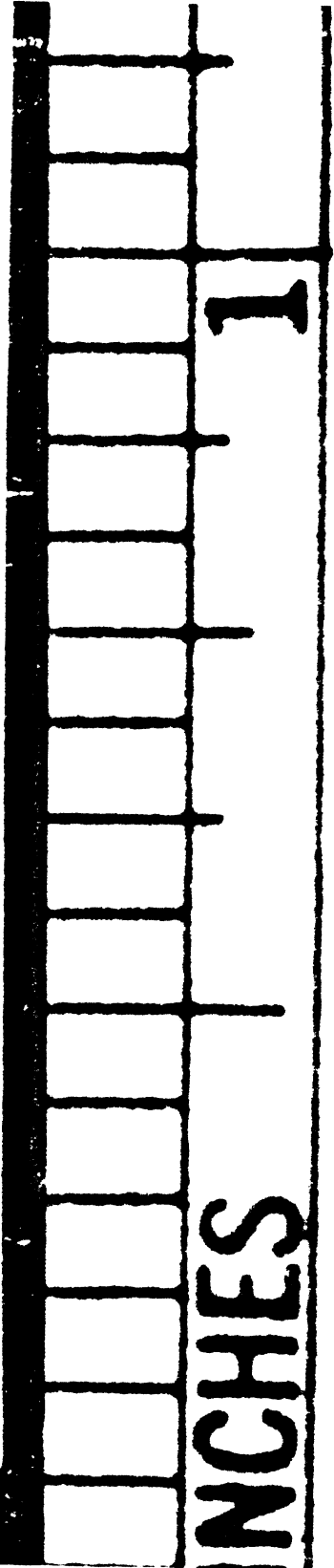
50ths

Subject 20406
Sample P-16
Mouth 70#





20606 R6

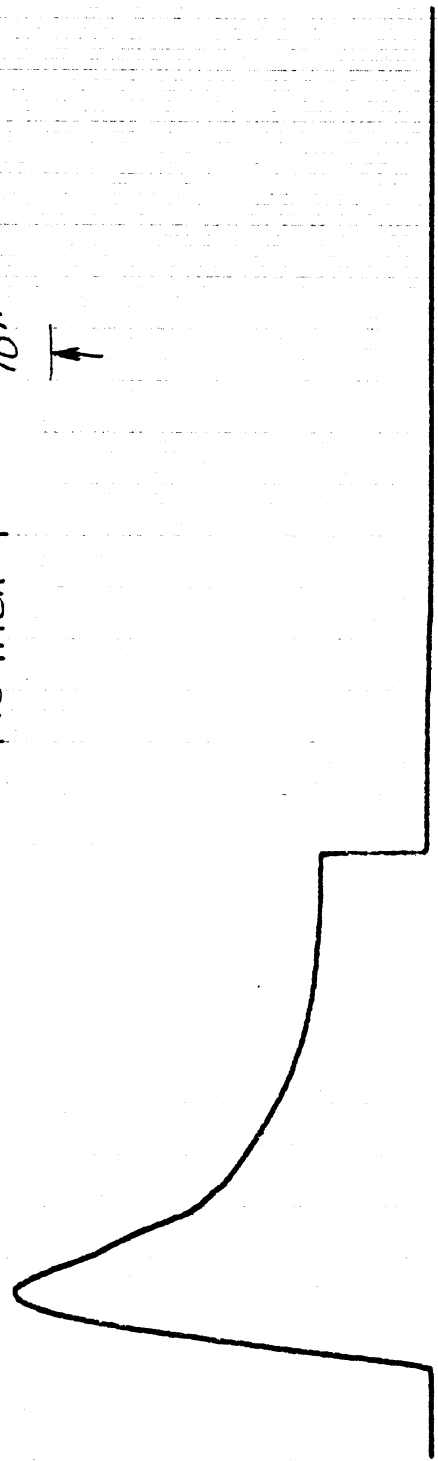


+ ↑

Subject 20606
Sample R7

→ 1/3 inch ←

↓ 10# ↓





20606 R7



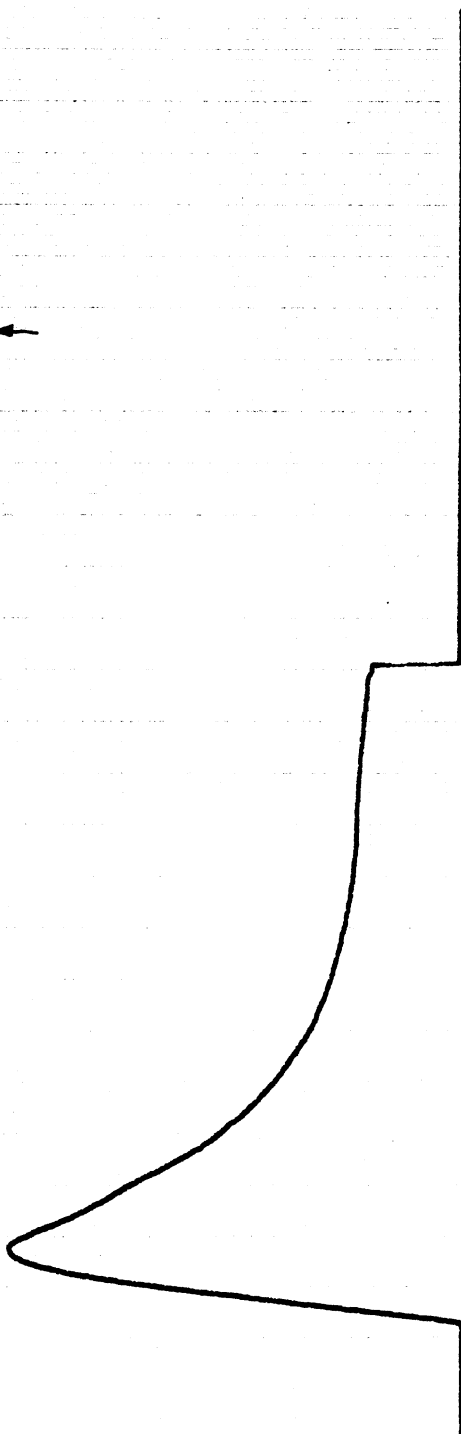
50ths

+ ↑

Subject 20606
Sample R8

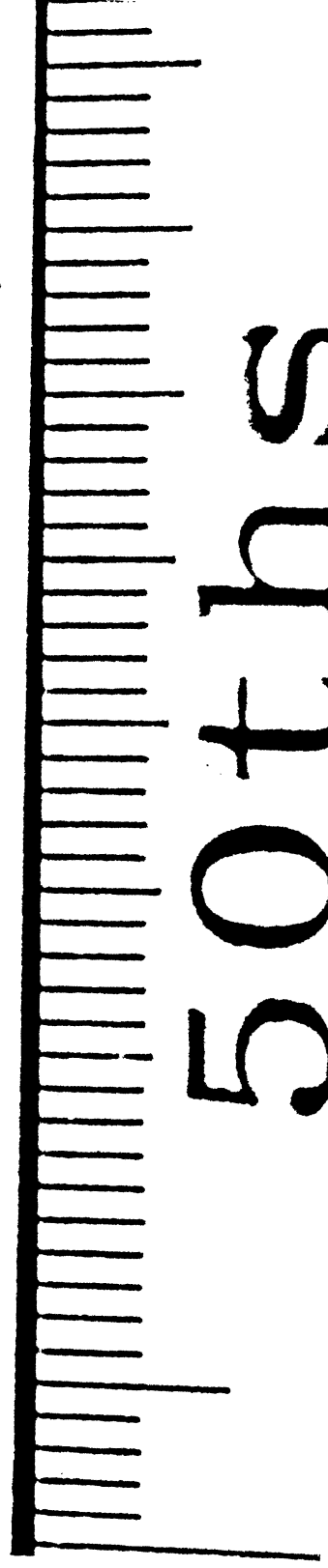
→ 1/3 inch

↓ 10# ↓





20606 R8



50ths

↑

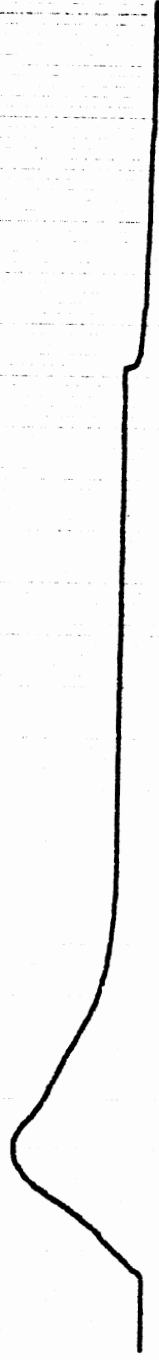
Subject
Sample

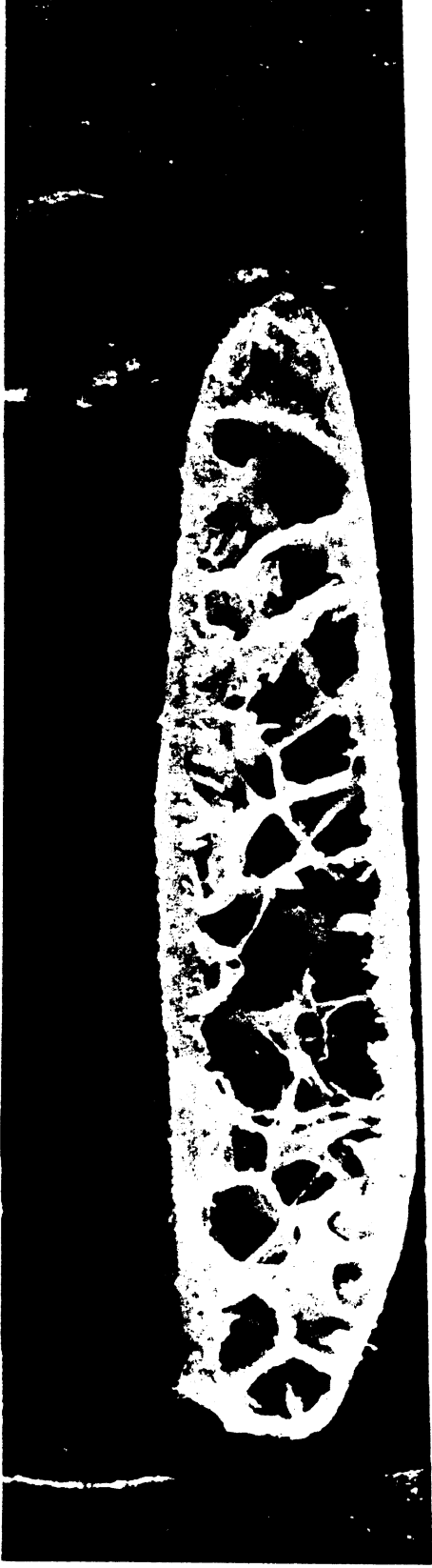
20615
L5

→ 1/3 inch ←

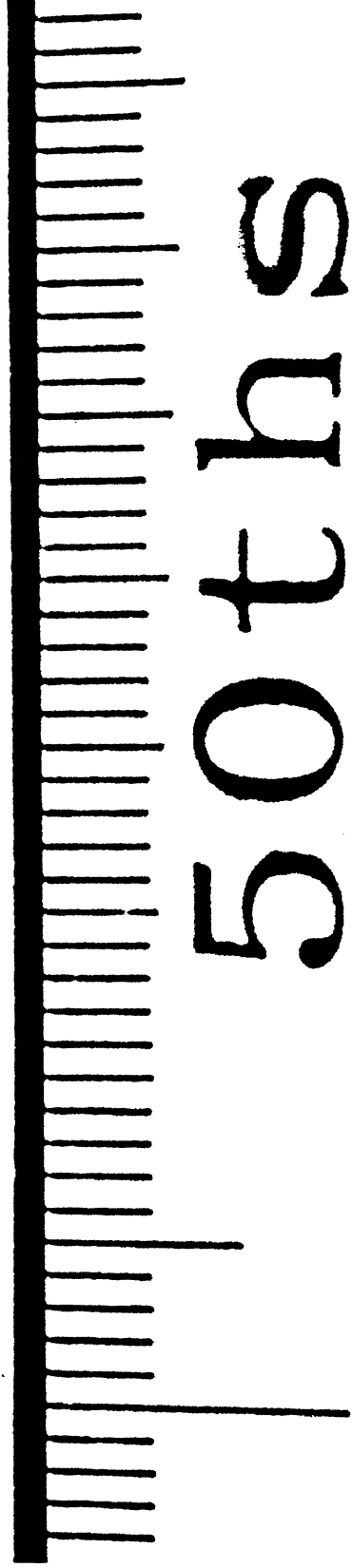
↓ 10# ↓

↑





2061515



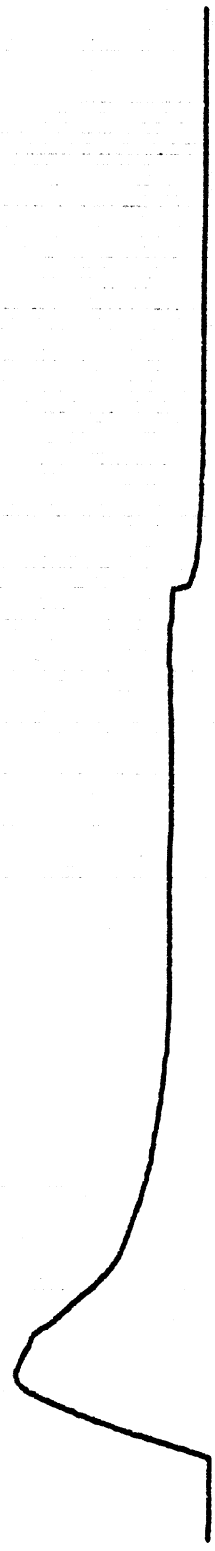
50ths

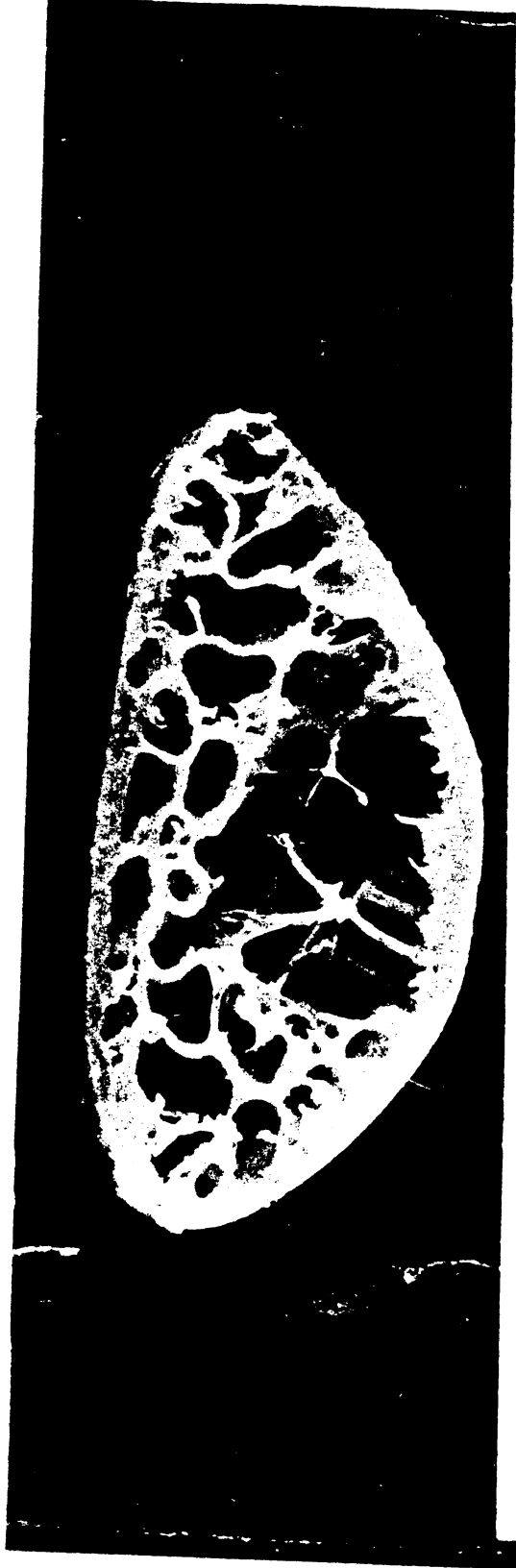
↑

Subject 20615
Sample L6

→ 1/3 inch ←

↓ 10# ↓

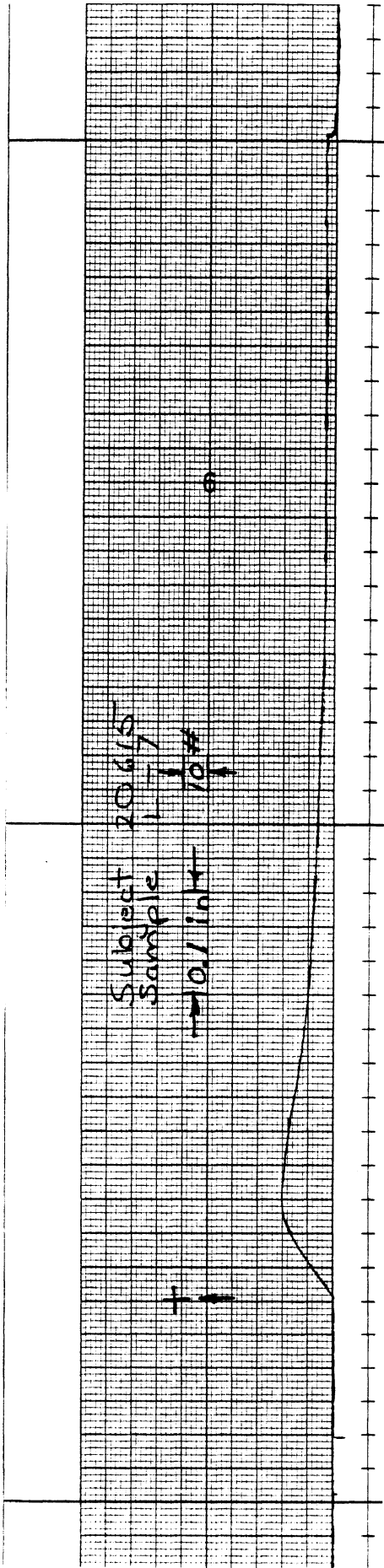


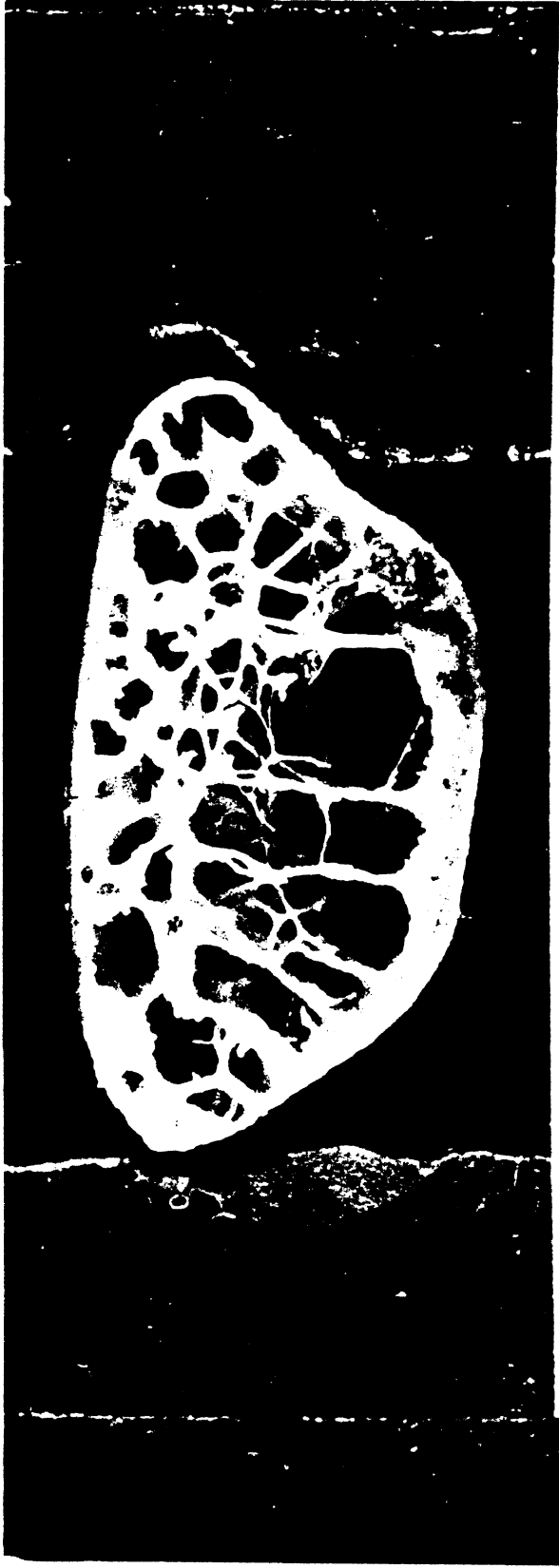


20615 I6

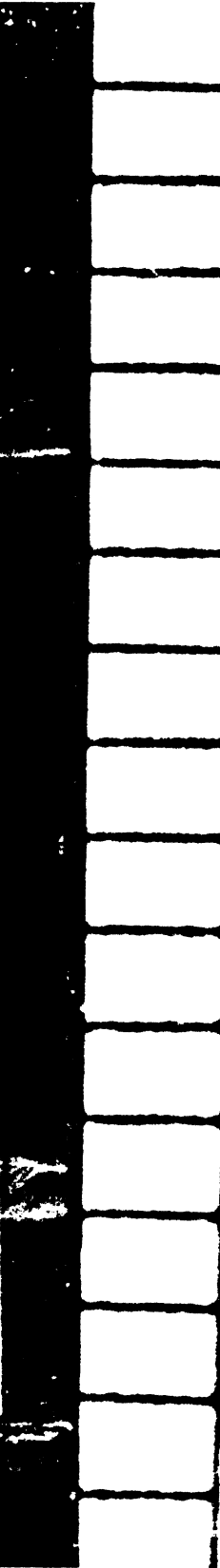


50ths





20615 177



INCHES

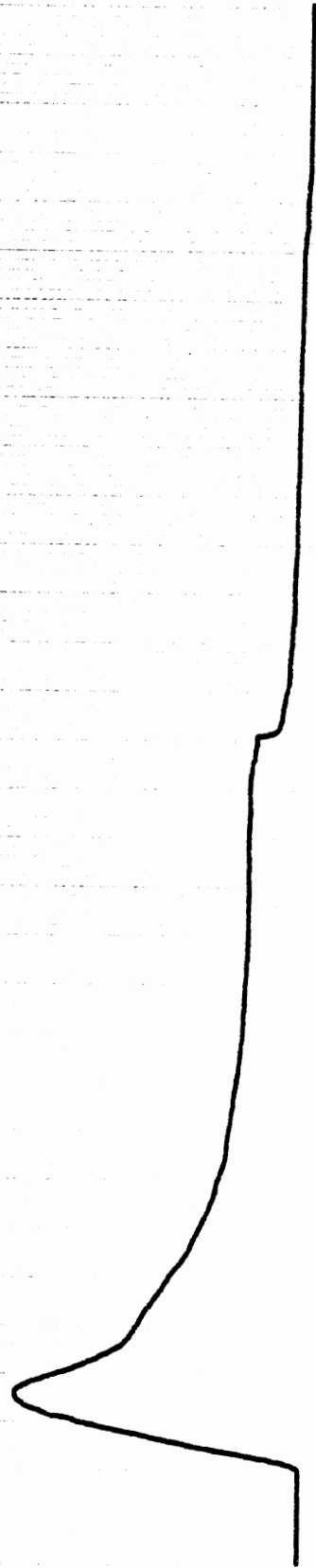
17

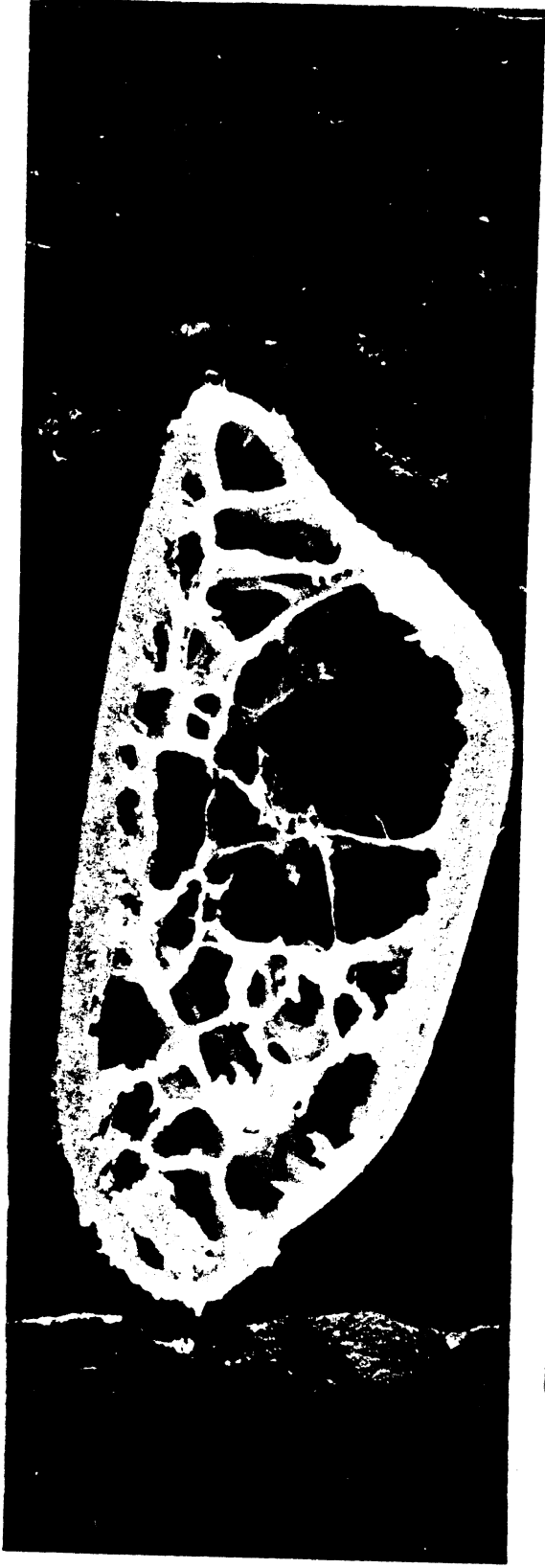
Subject 20615
Sample L8

→ 1/3 inch

→ 10#

+ →





20615 L8



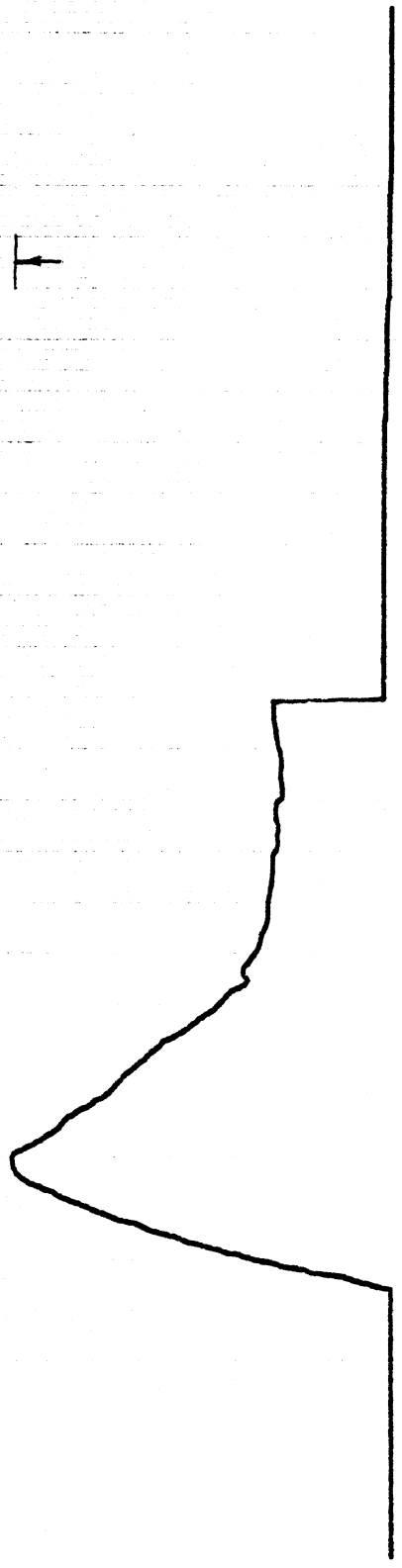
50ths

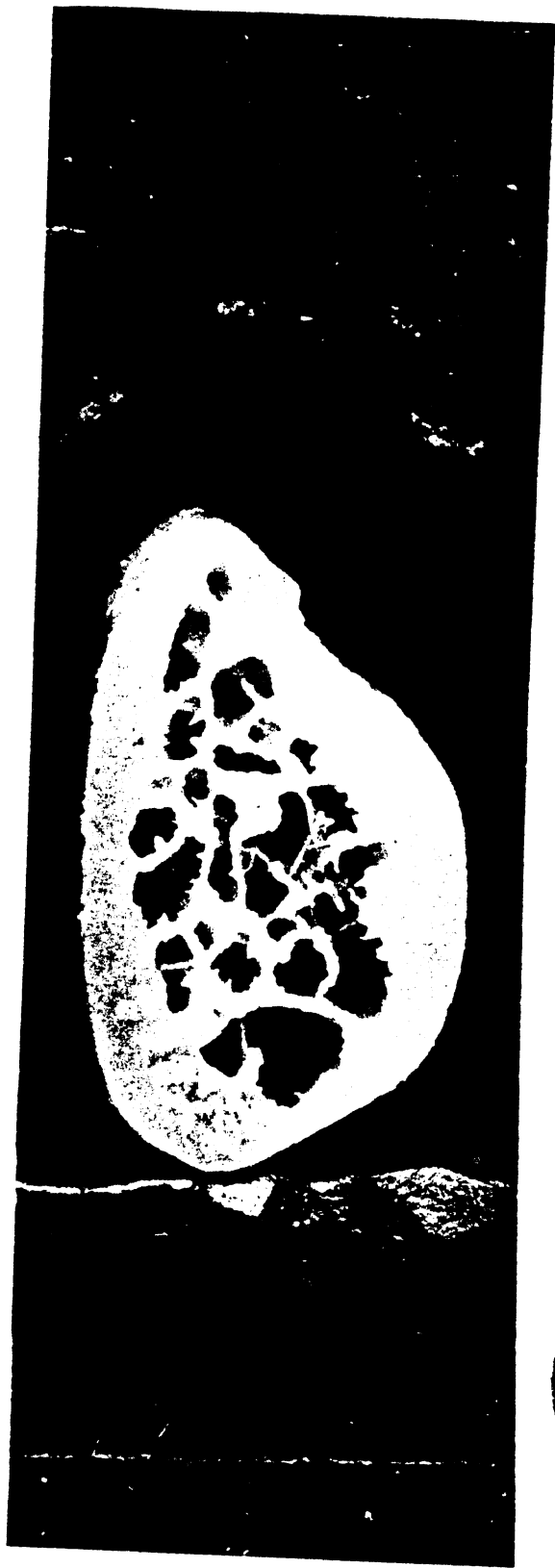
+ ↑

Subject 20616
Sample L4

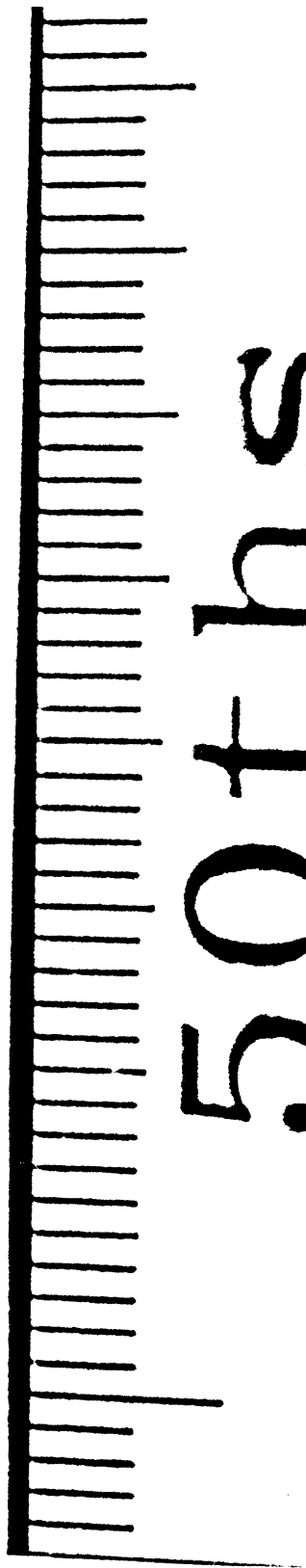
→ 1/3 inch ↓

↓ 10# ↓





20616 L4



50ths

+ ↑

Subject
Sample

→ 1/3 inch ←

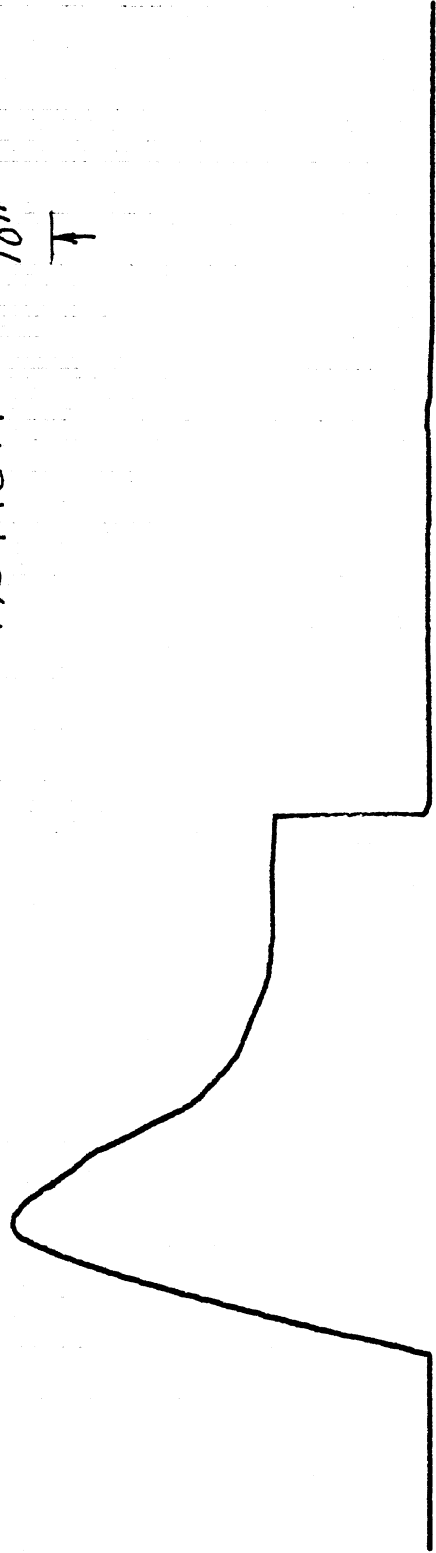
20616

L6

↓

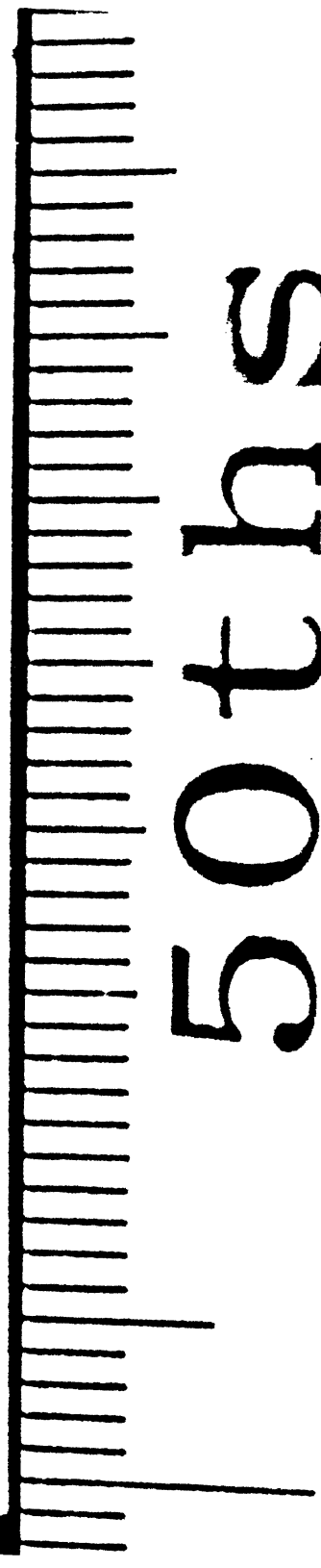
10#

↑





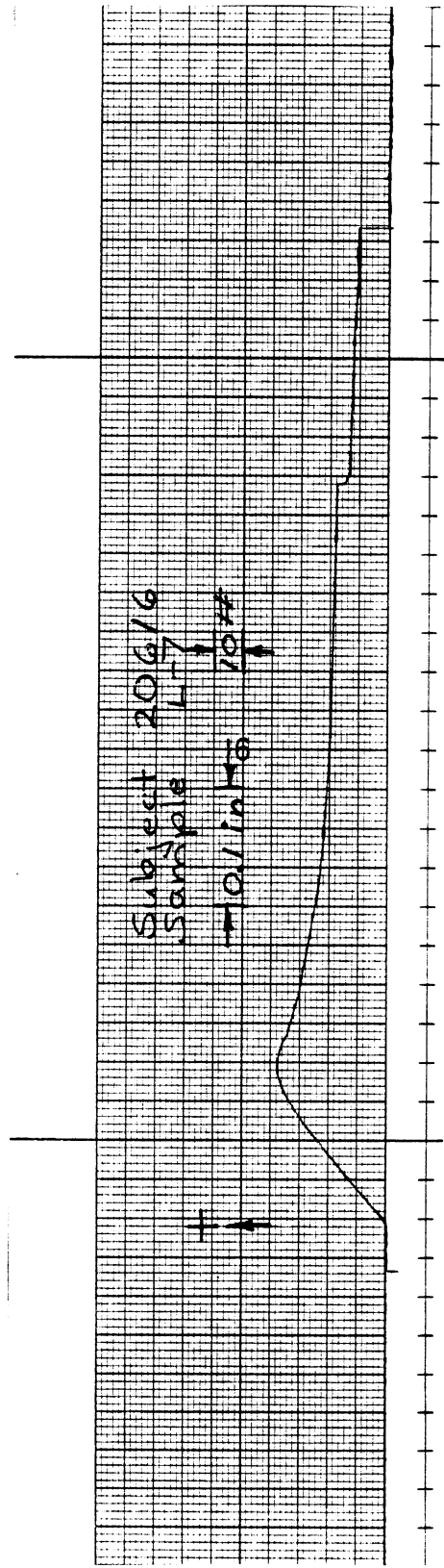
20616 I6

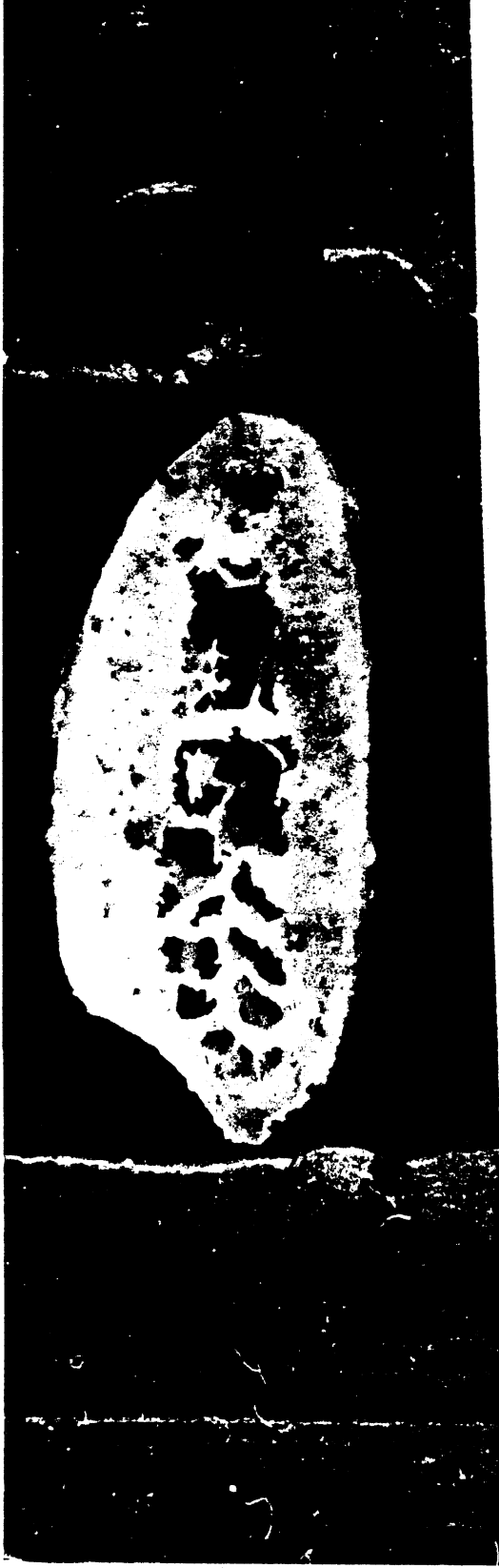


Subject 206/6
Sample L-7

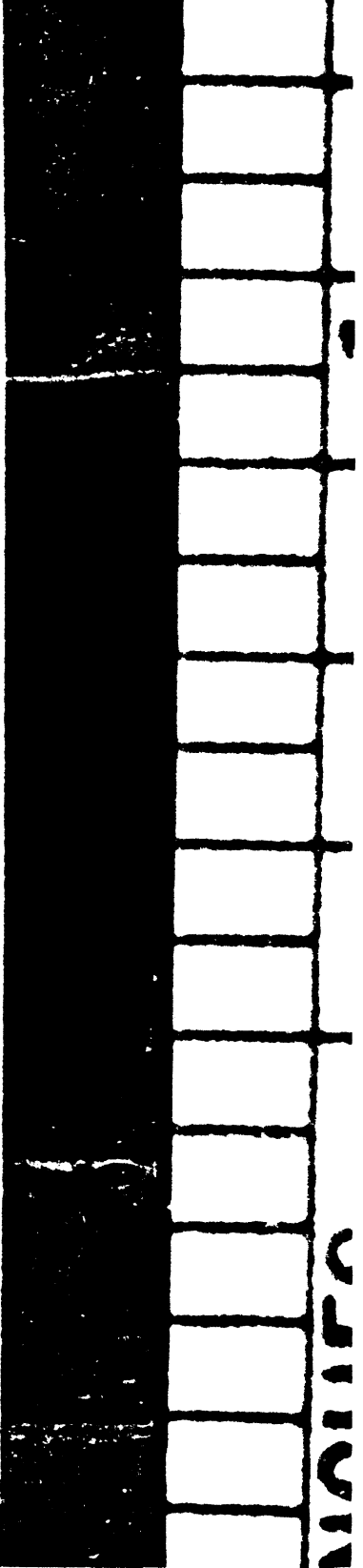
10/10/50 10/11

T





200616 117

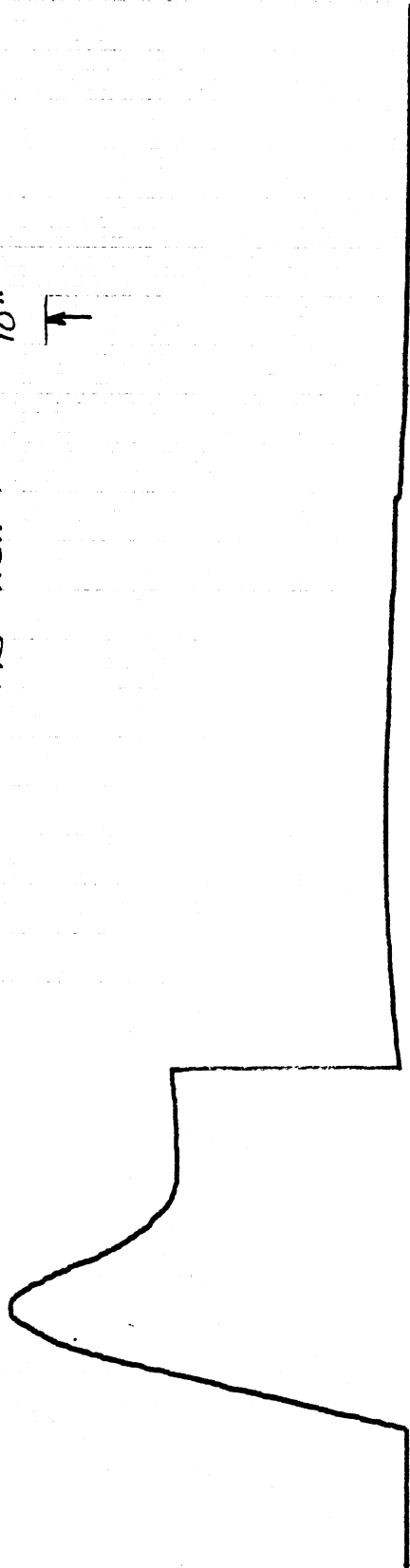


+ ↑

Sample = 20616
Subject L8

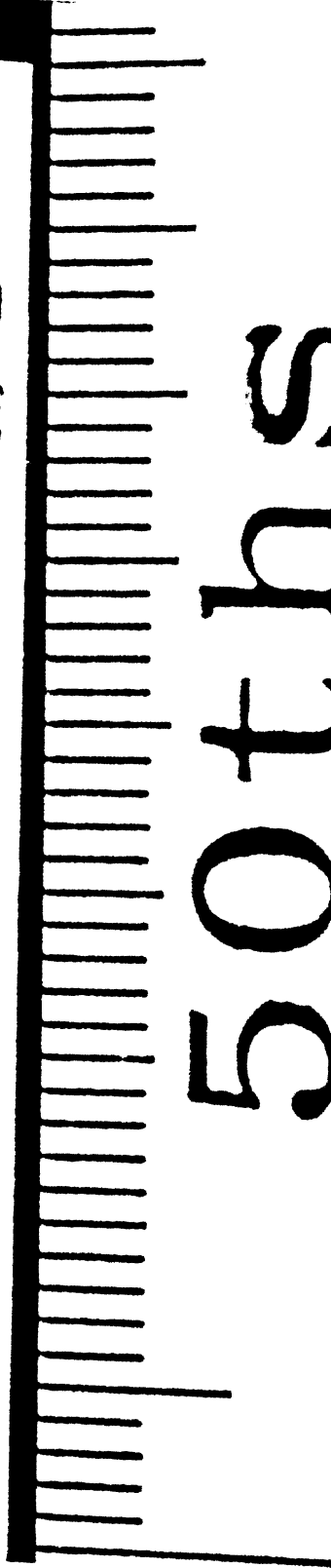
→ 1/3 inch ←

↓ 10# ↑





20616 L8



50ths

+ ↑

Sample 20621
Subject R5

→ 1/3 inch ←

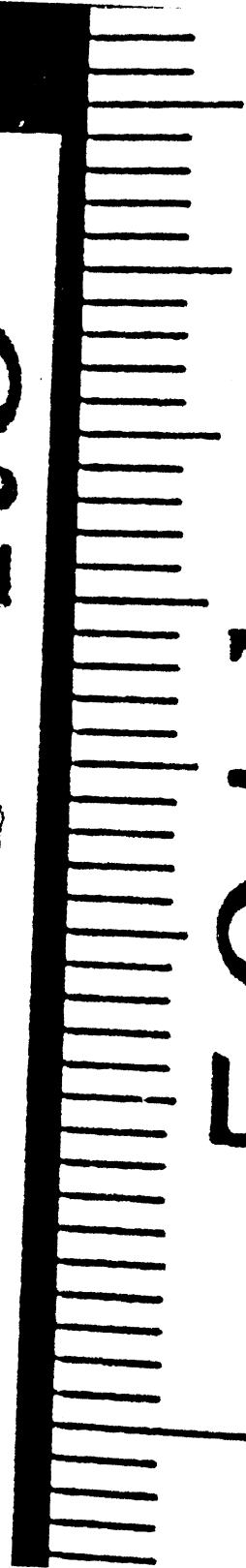
↓ 10# ↓

(Test Failure)





20621 R5



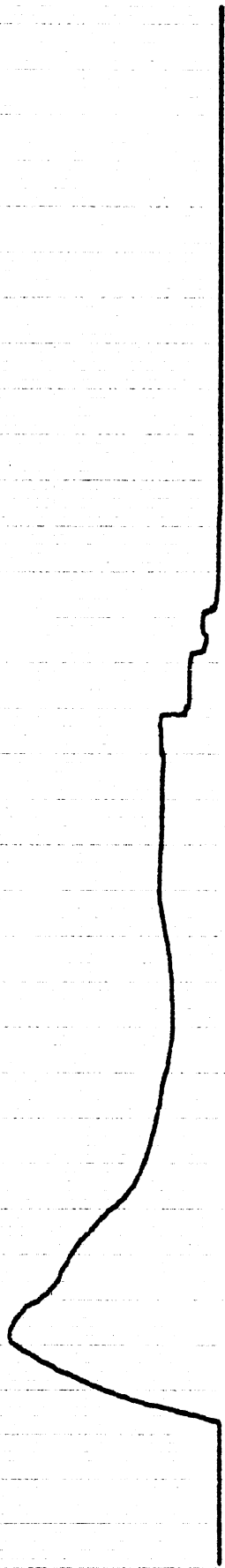
50ths

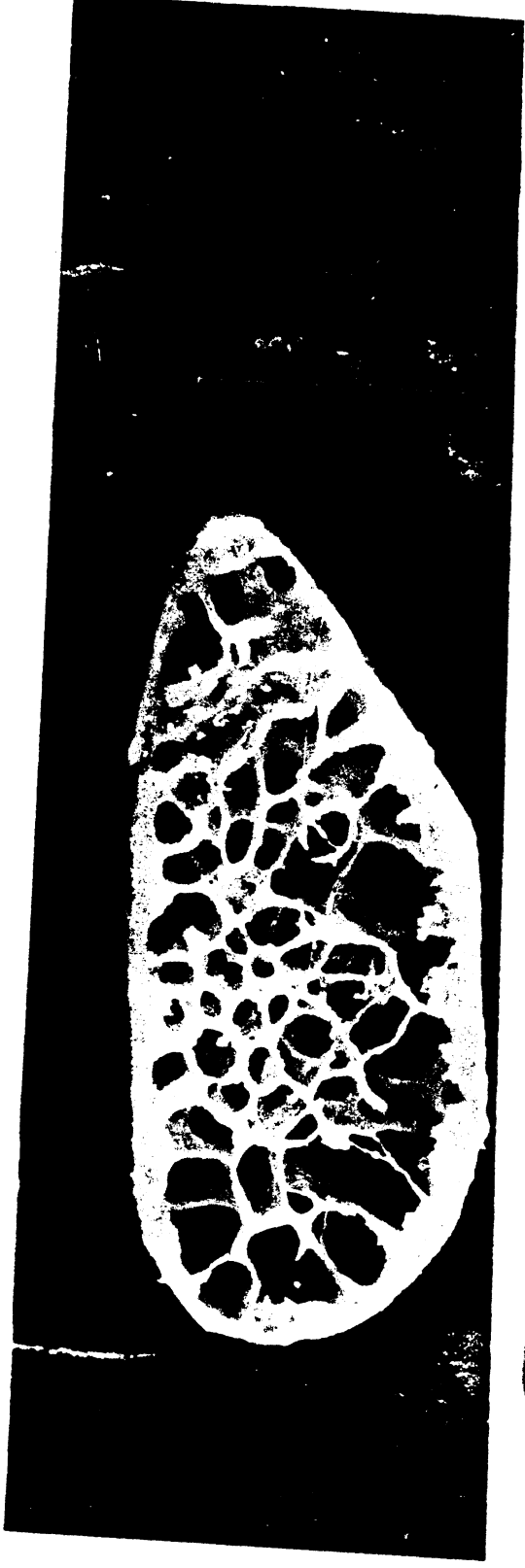
Subject 20621
Sample R6

→ 1/3 inch ←

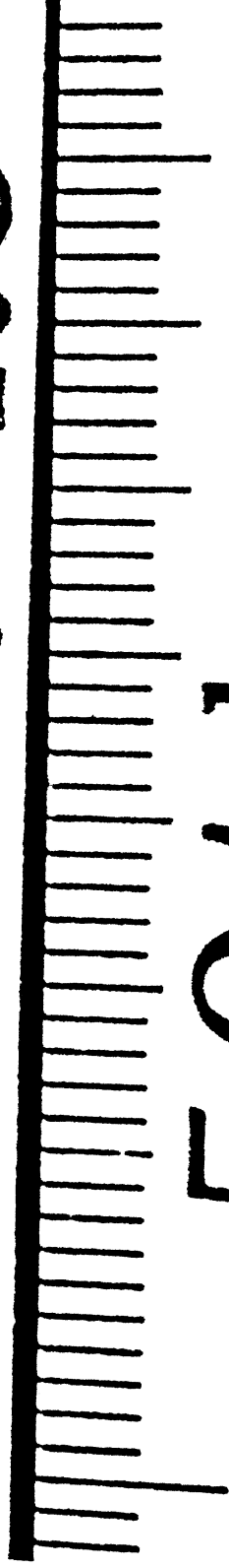
↓ 10# ↑

+ ↑



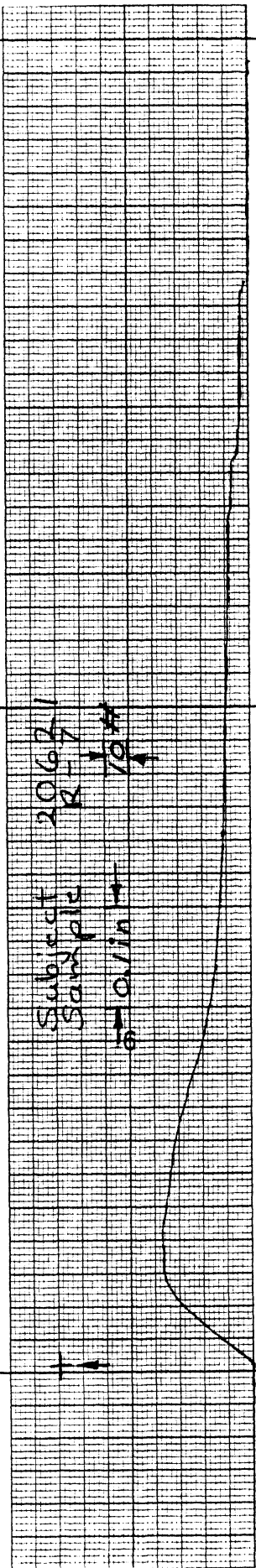


20621 R6



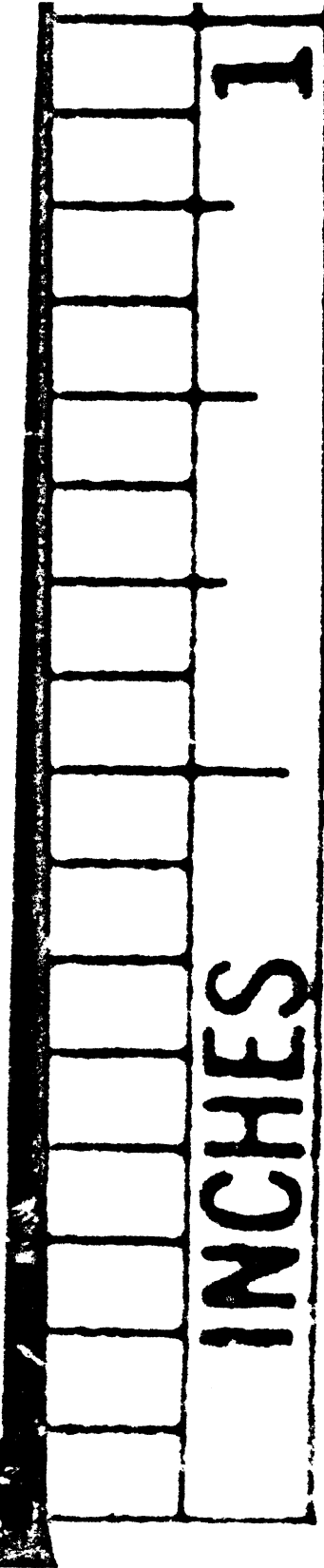
50ths

Subject 20621
Sample R-7
6-0.1in 10A





20621 R7



INCHES

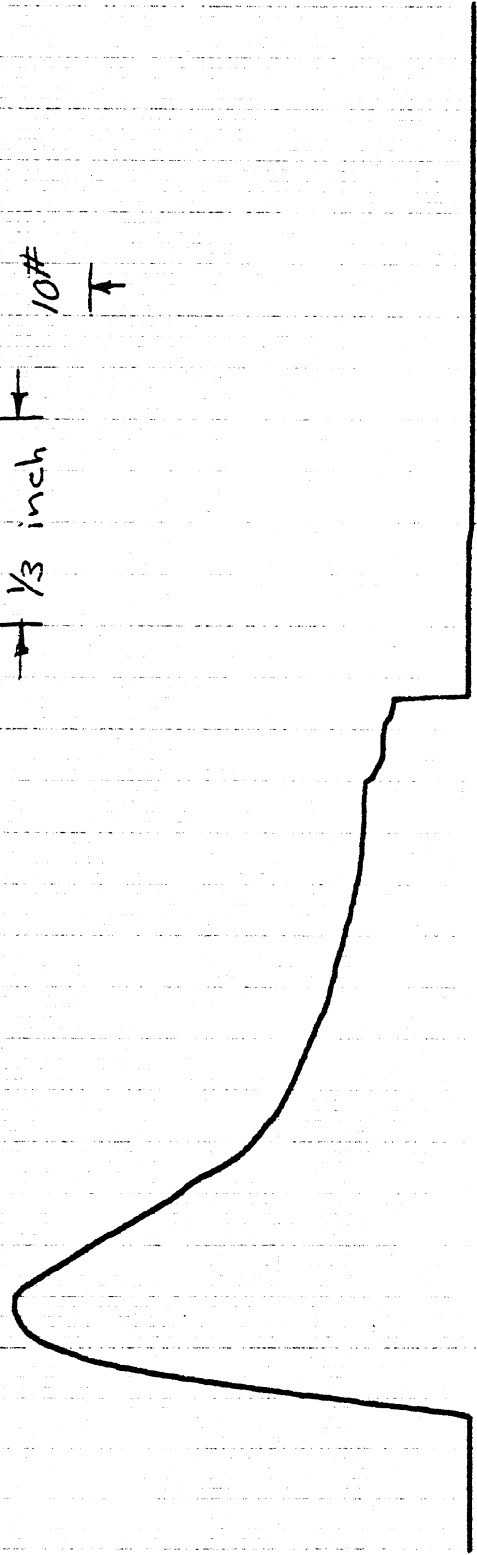
1

Subject 20629
Sample L5

→ 1/3 inch ←

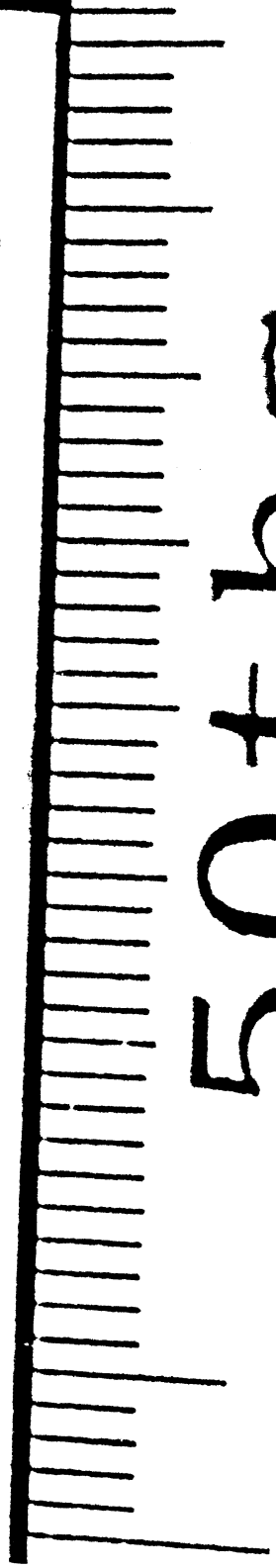
↓ 10# ↓

+ ↑





20629 I5



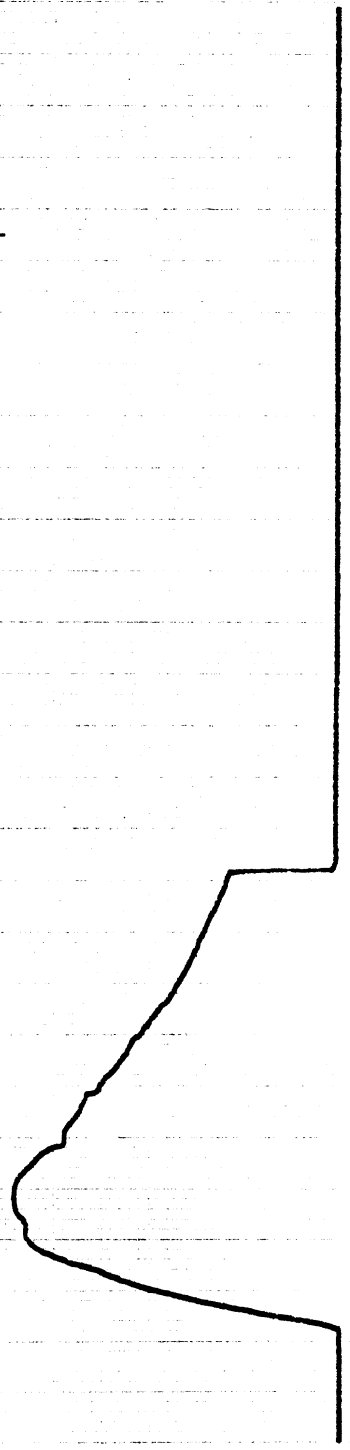
50+hs

Subject 20629
Sample L6

10#

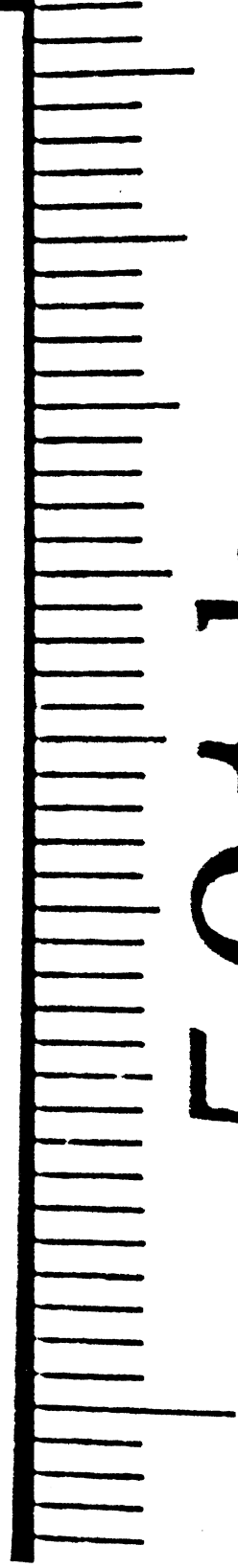
1/3 inch

+ →





20629 L6



50+hc

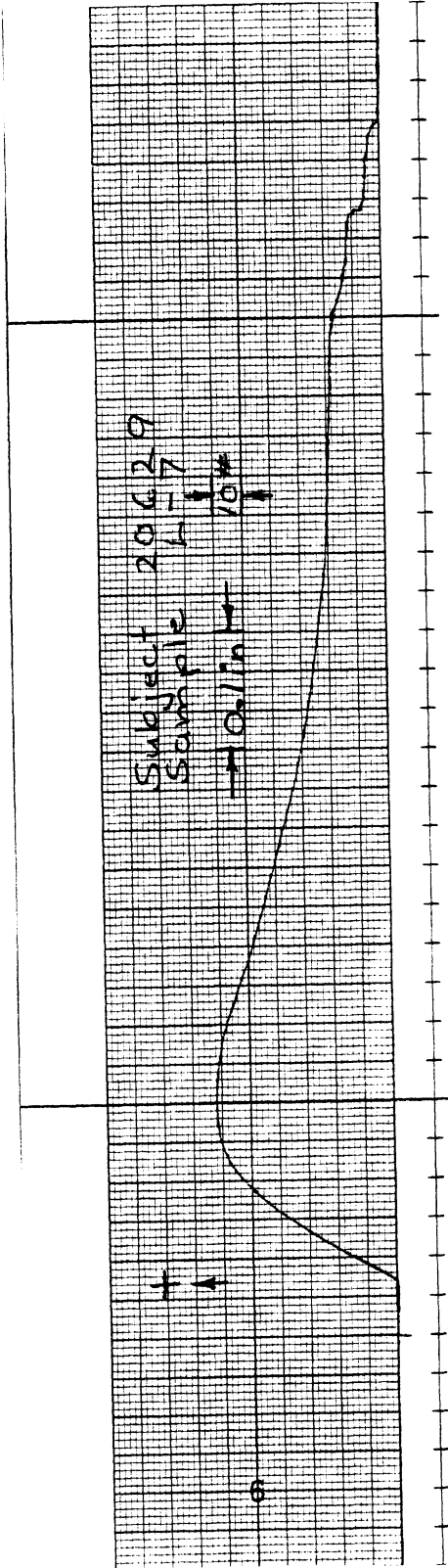
Subject 20629
Sample 1-7

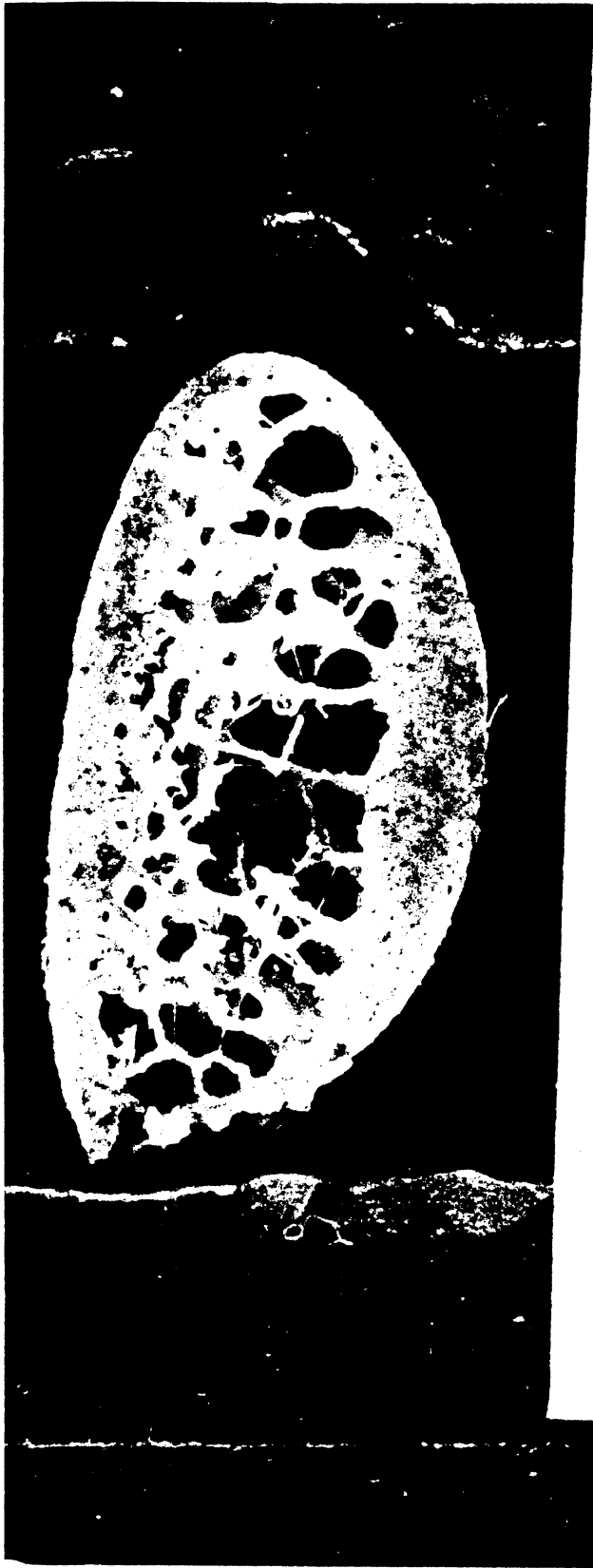
10.10
10.1

↑

↑

6





20629 I77



INCHES

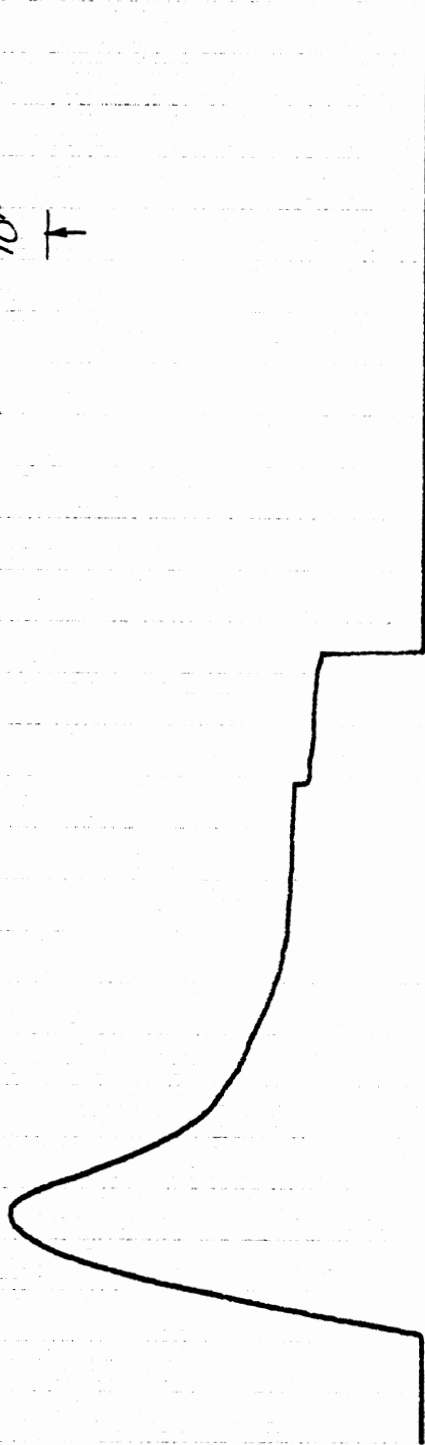
1

+

Subject 20629
Sample L8

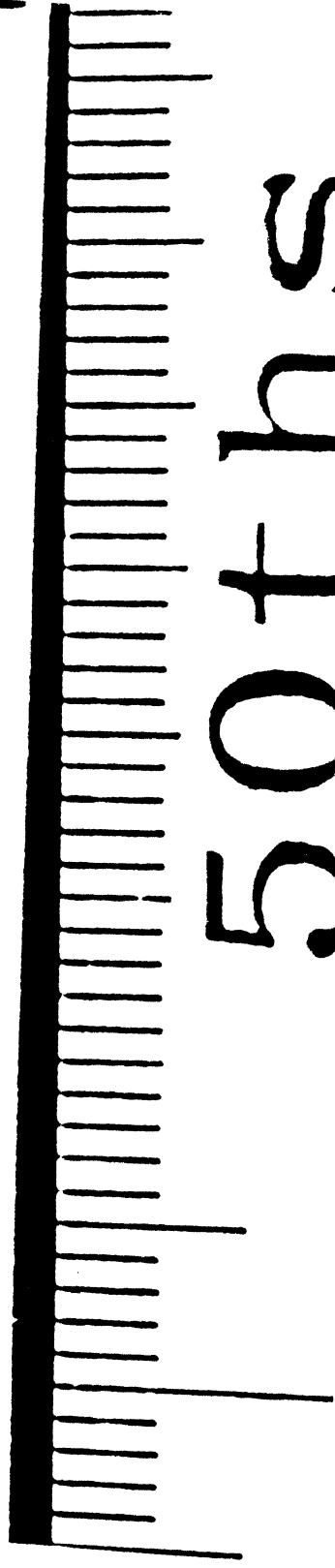
→ 1/3 inch

→ 10#





20629 L8



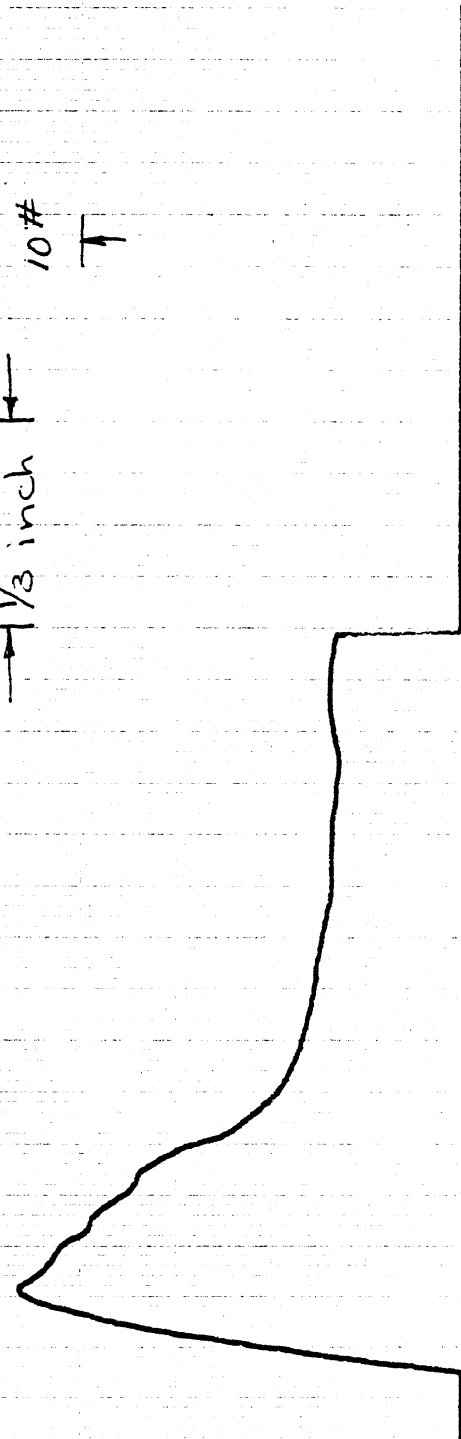
50ths

20761
L 4
10#

Subject
Sample

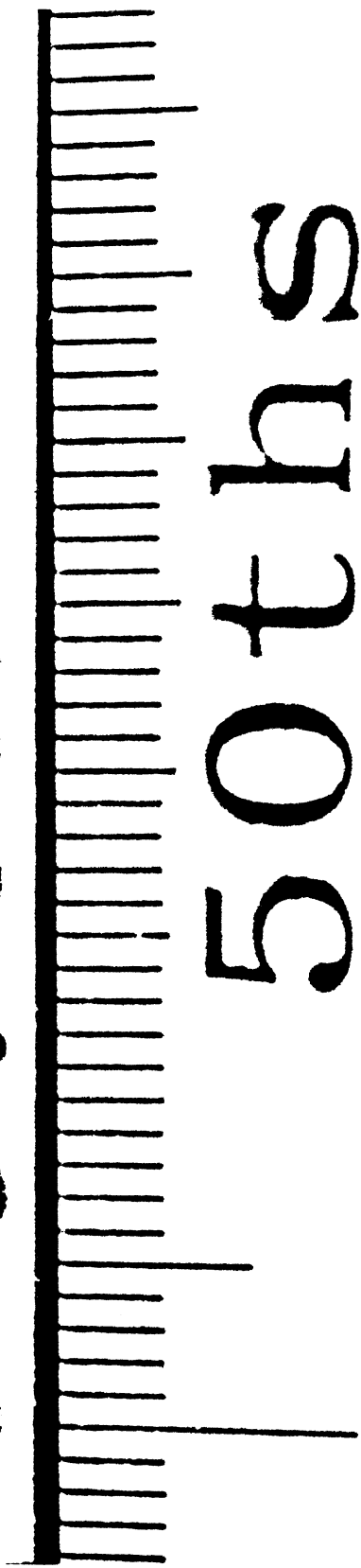
1/3 inch

+ ↑





2076114



50ths

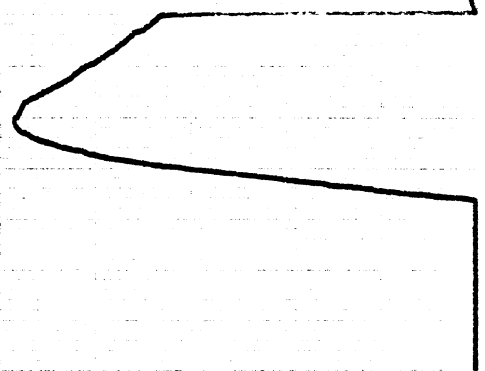
Subject
Sample

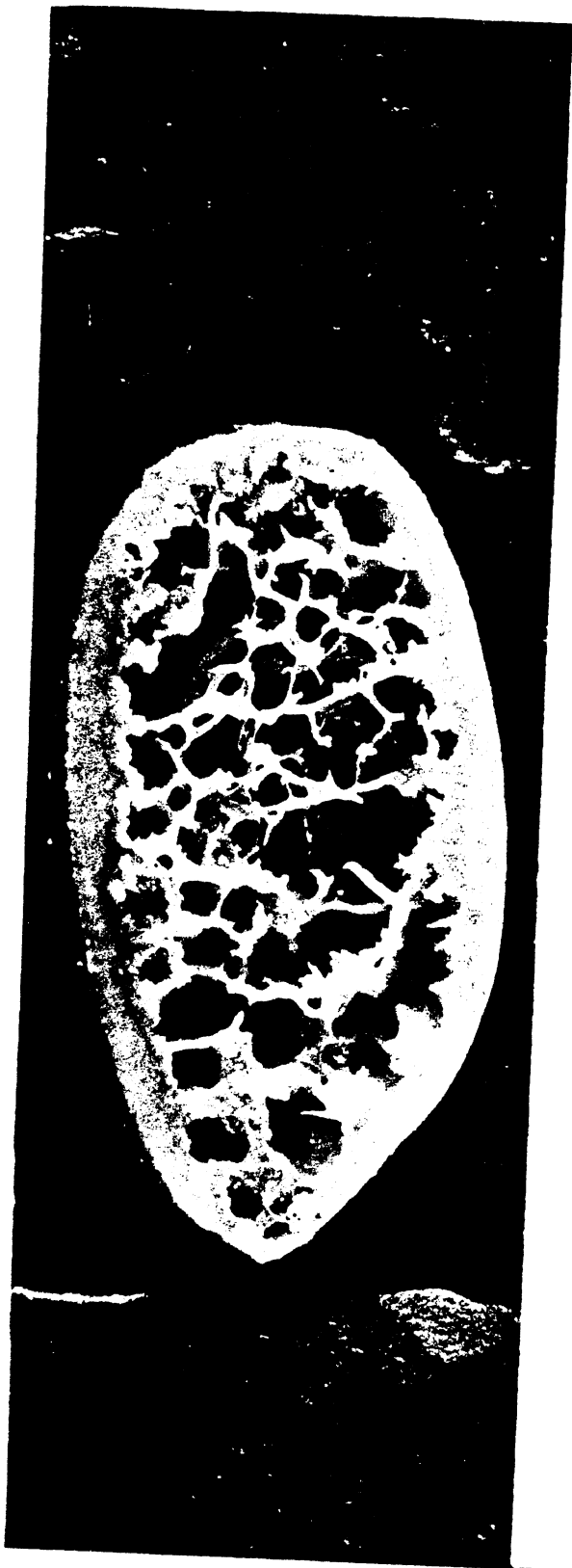
20761
L5

1/3 inch

10#

+





20761 I5

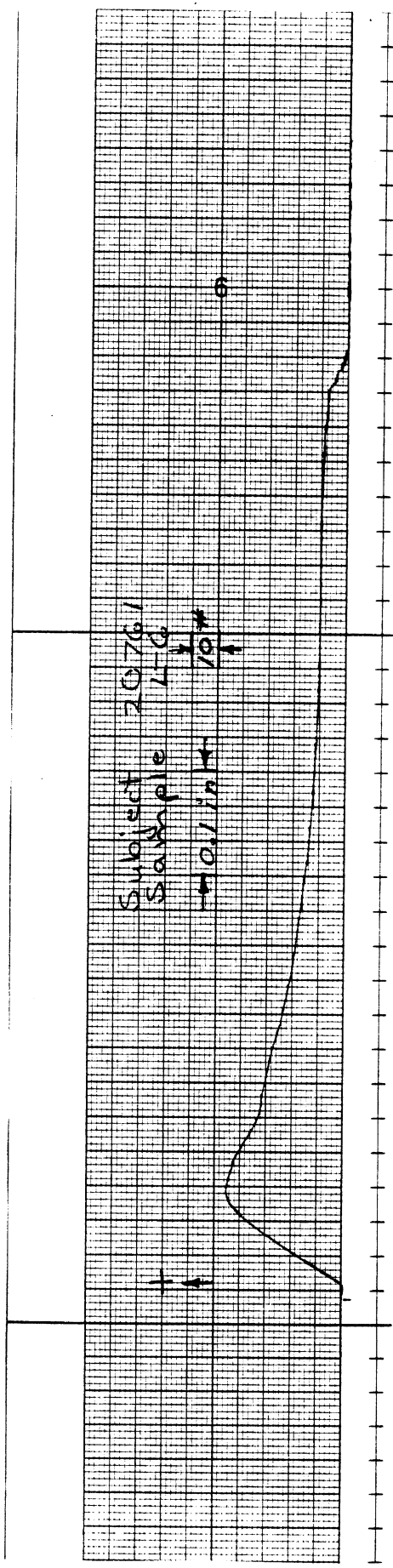


50+hs

Subject 20761
Sample 1-9
Molins 101#

↑

6





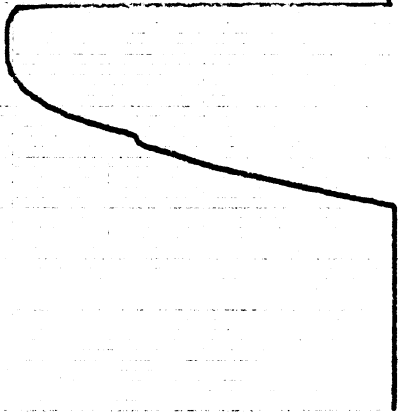
2076116

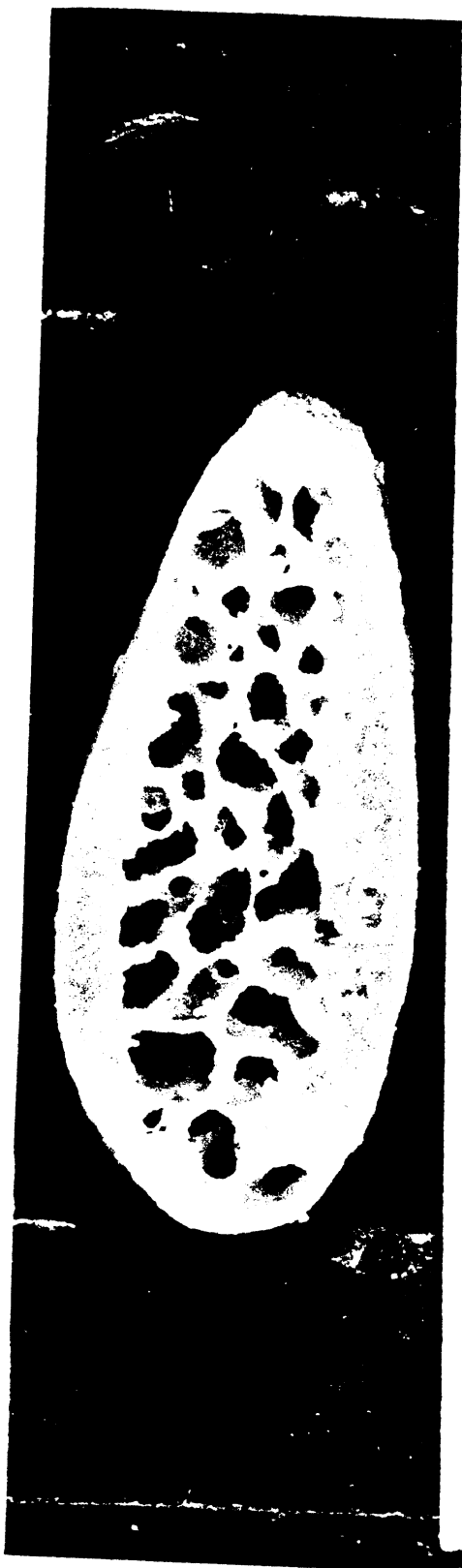


Subject 20765
Sample L4

$\frac{1}{3}$ inch

10#





20765 I4



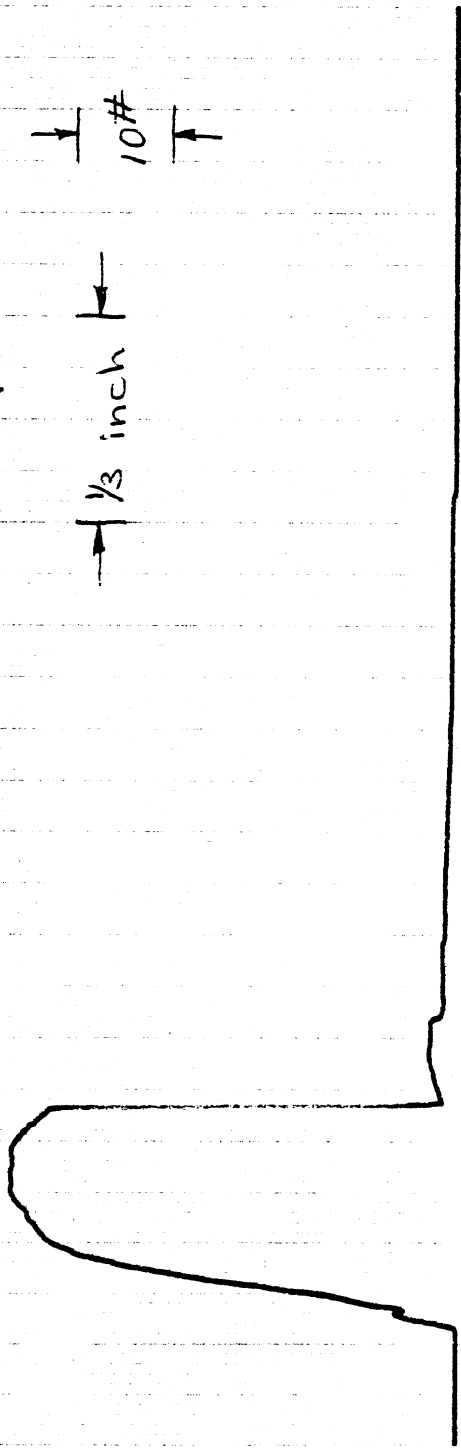
50ths

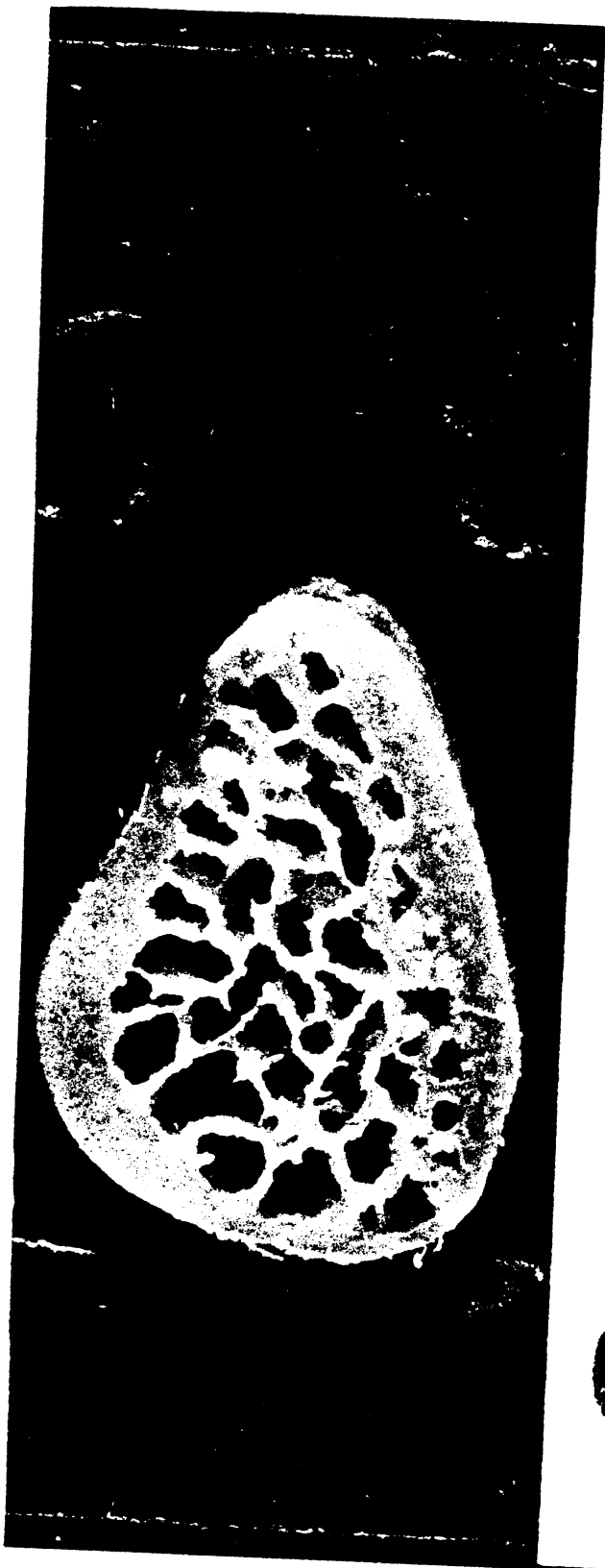
Subject 20765
Sample L5

→ 1/3 inch ←

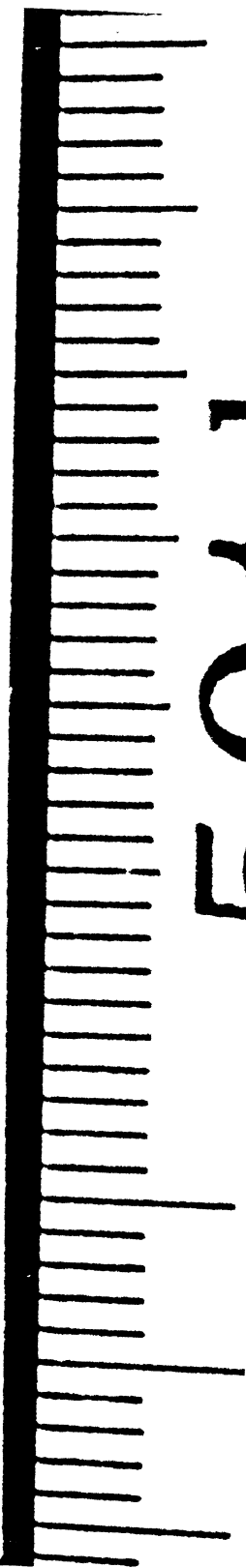
↓ 10# ↑

+ →





20765 L5

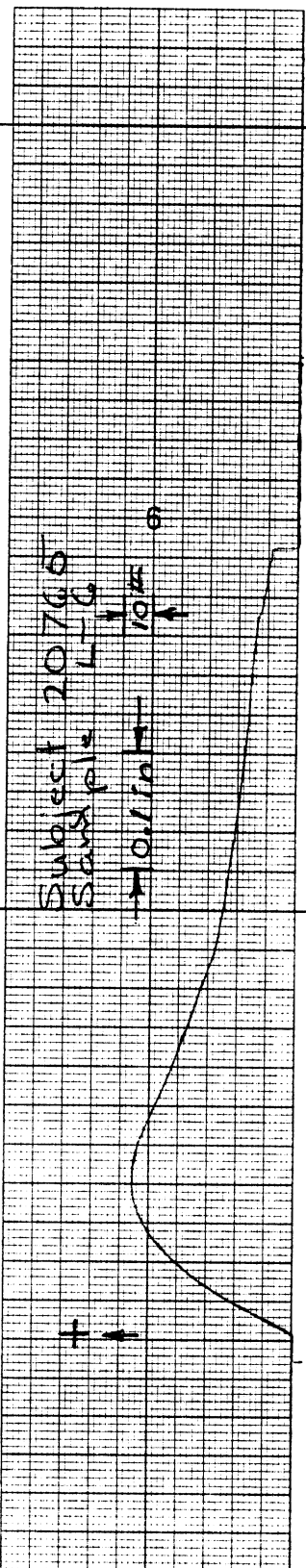


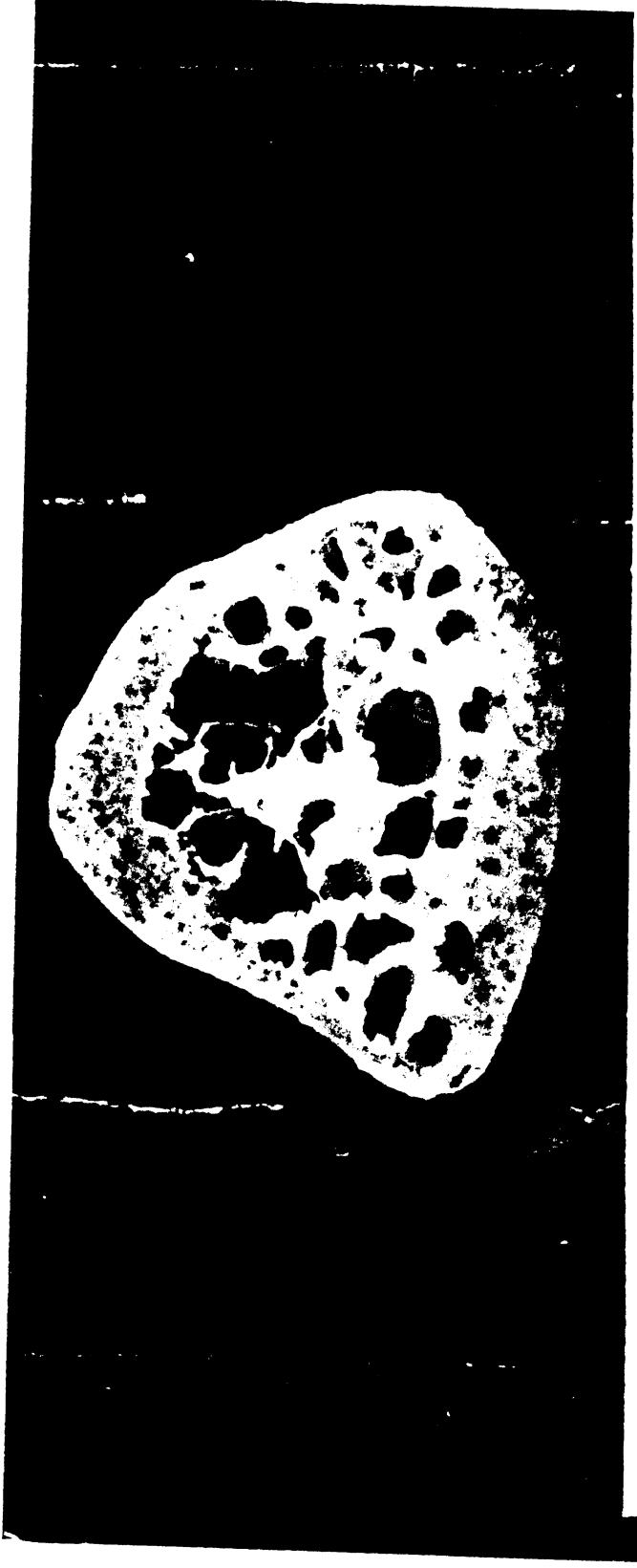
F O + L

Subject 20766
Sample L-6

Horizontal
↑

↑





20765 I6



+ →

Subject 20774
Sample L4

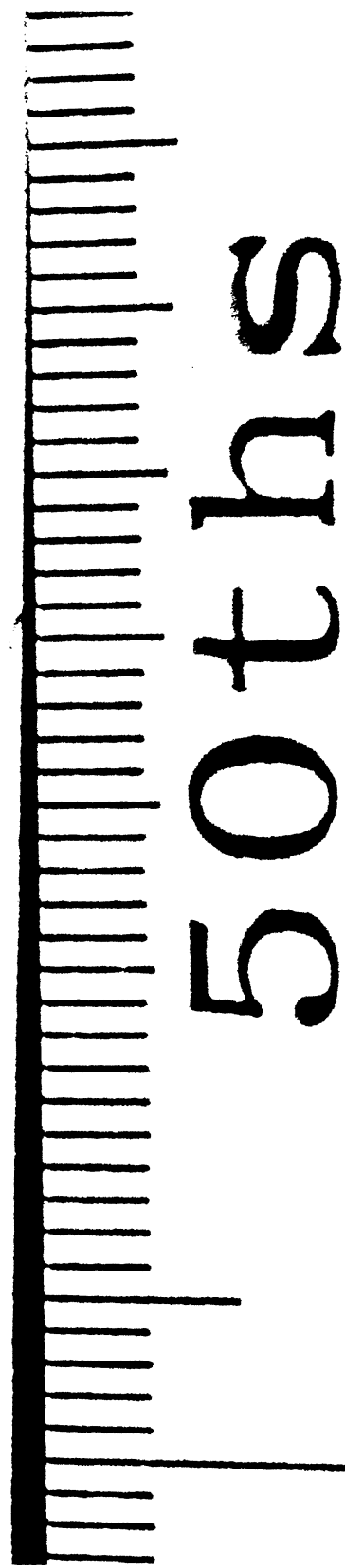
→ 1/3 inch ←

→ 10# ←



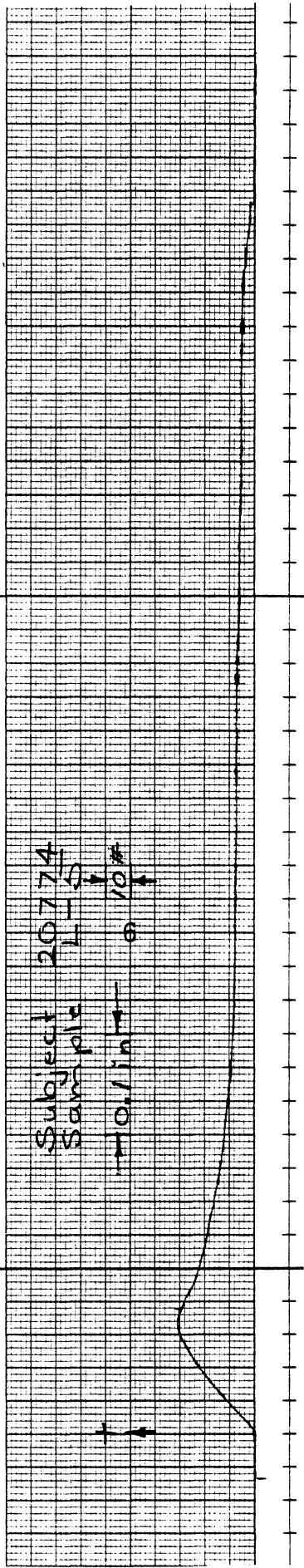


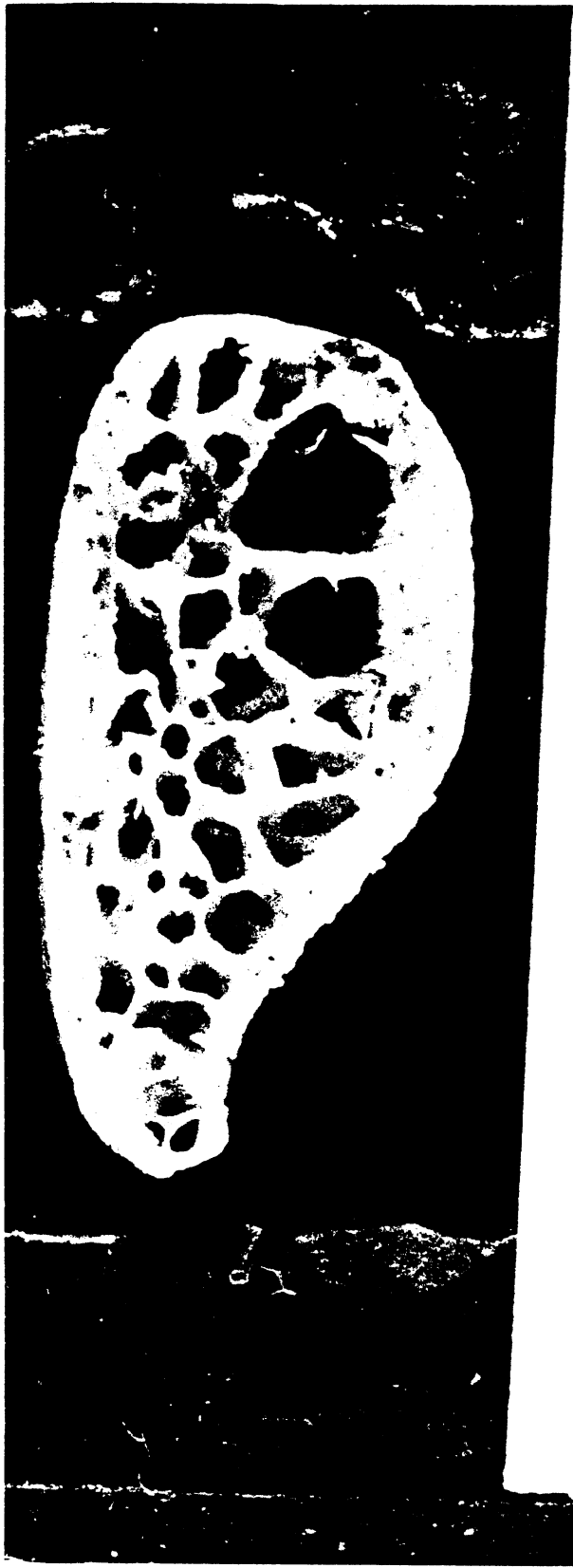
20774 LA



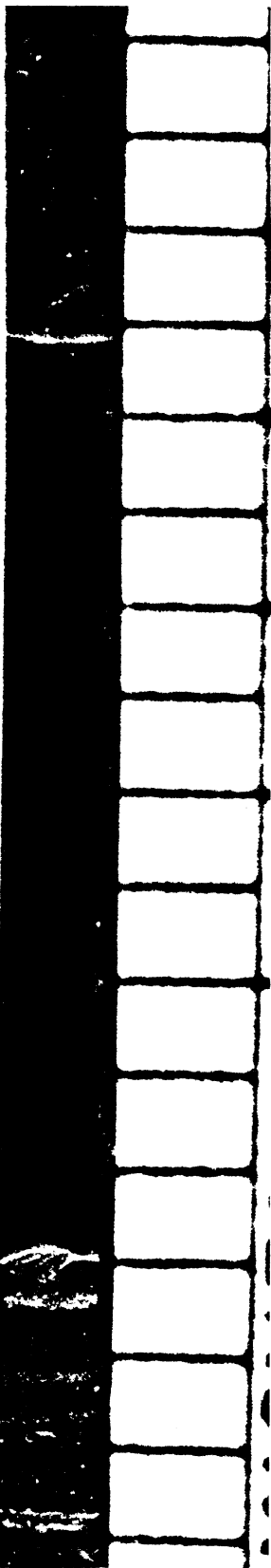
50ths

Subject 2077A
Sample L-9
10.1 in
10#





20774 115

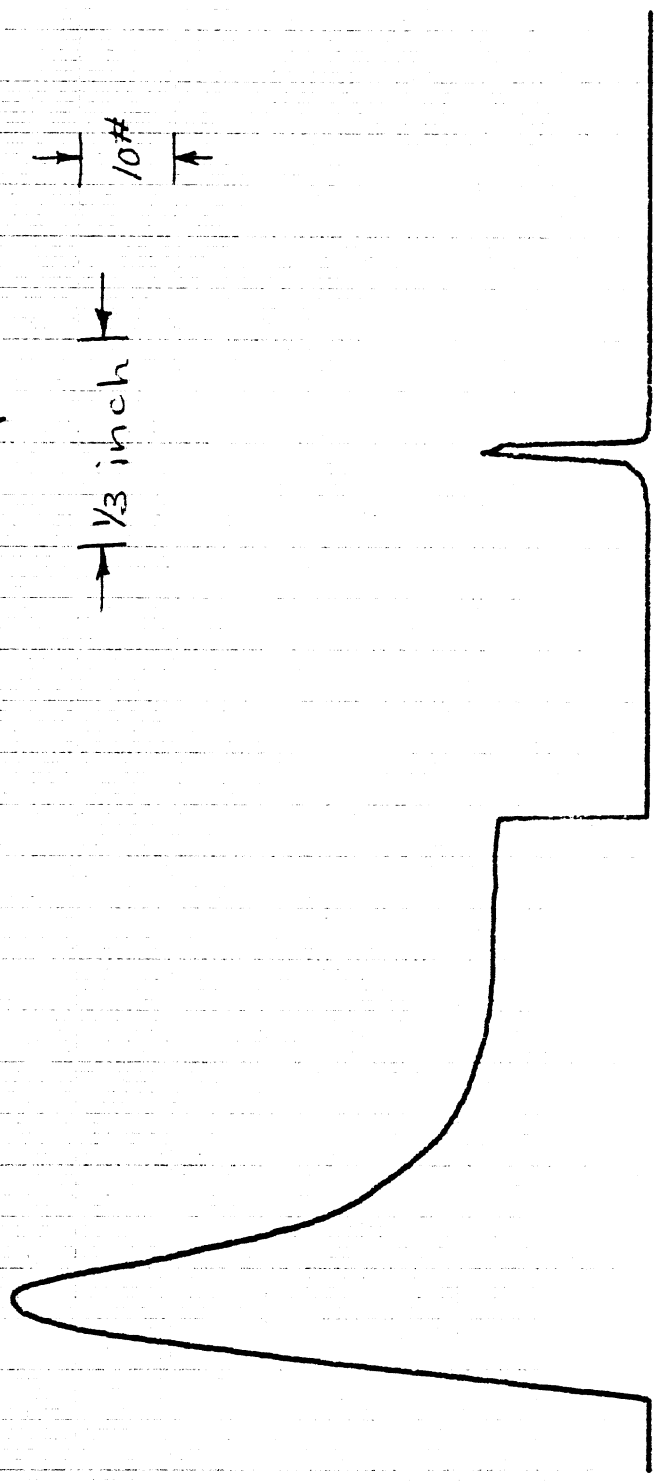


Subject 20774
Sample L-6

10#

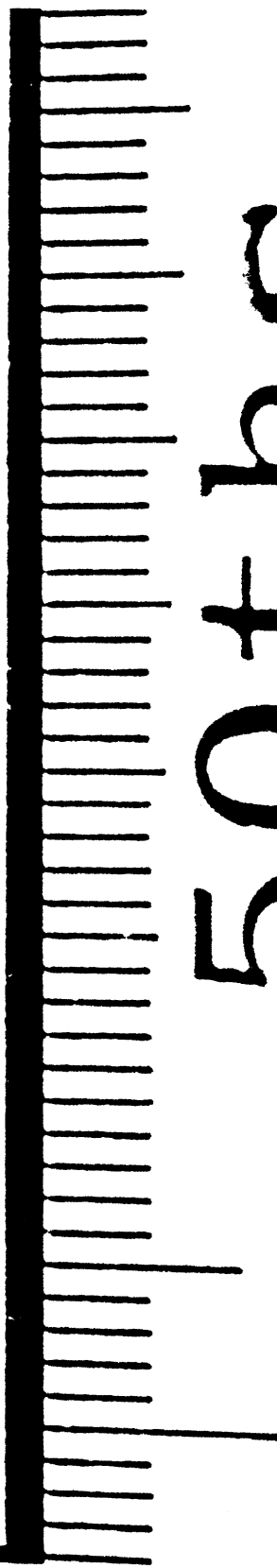
1/3 inch

+





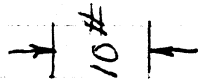
20774 16



50+ h a

20777

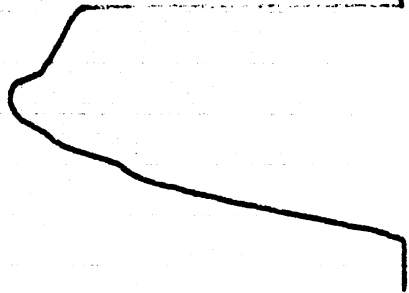
R4

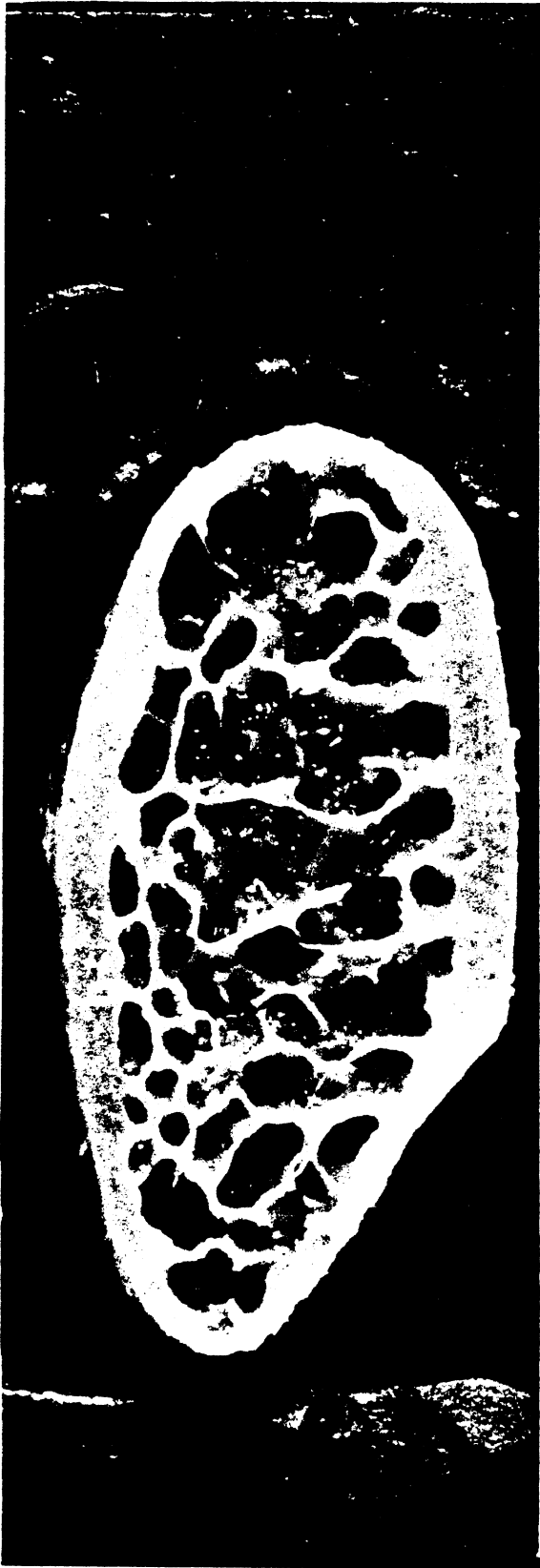


Subject
Sample



+ ↑





20777 RA



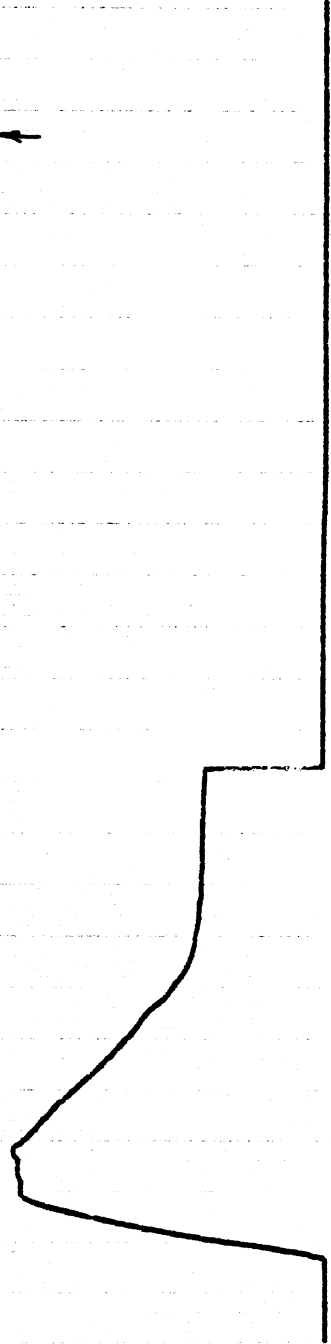
50ths

Subject 20777
Sample R5

→ 1/3 inch ←

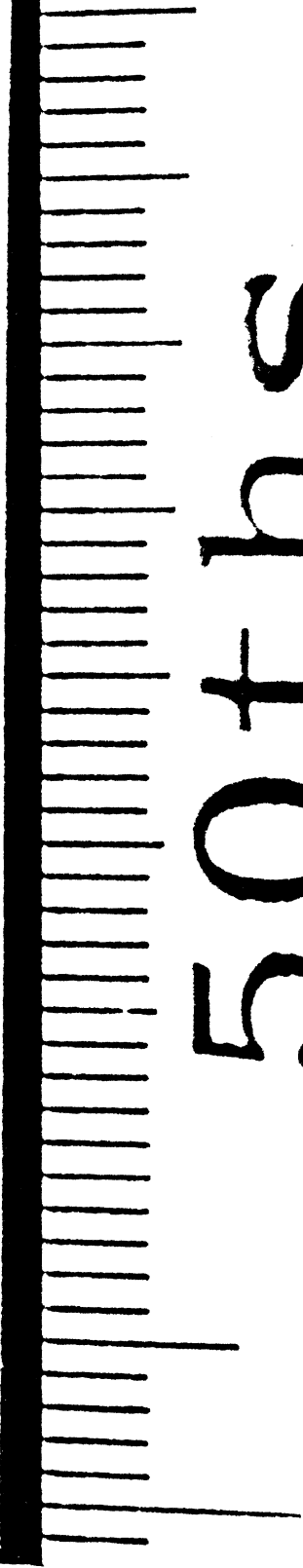
↓ 10# ↓

+ ↑





20777 R5



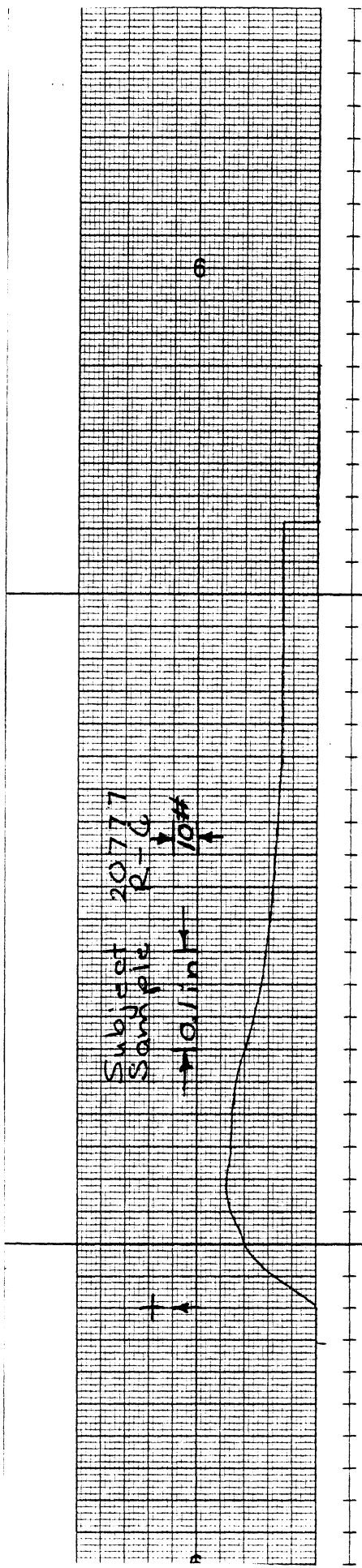
50 fhs

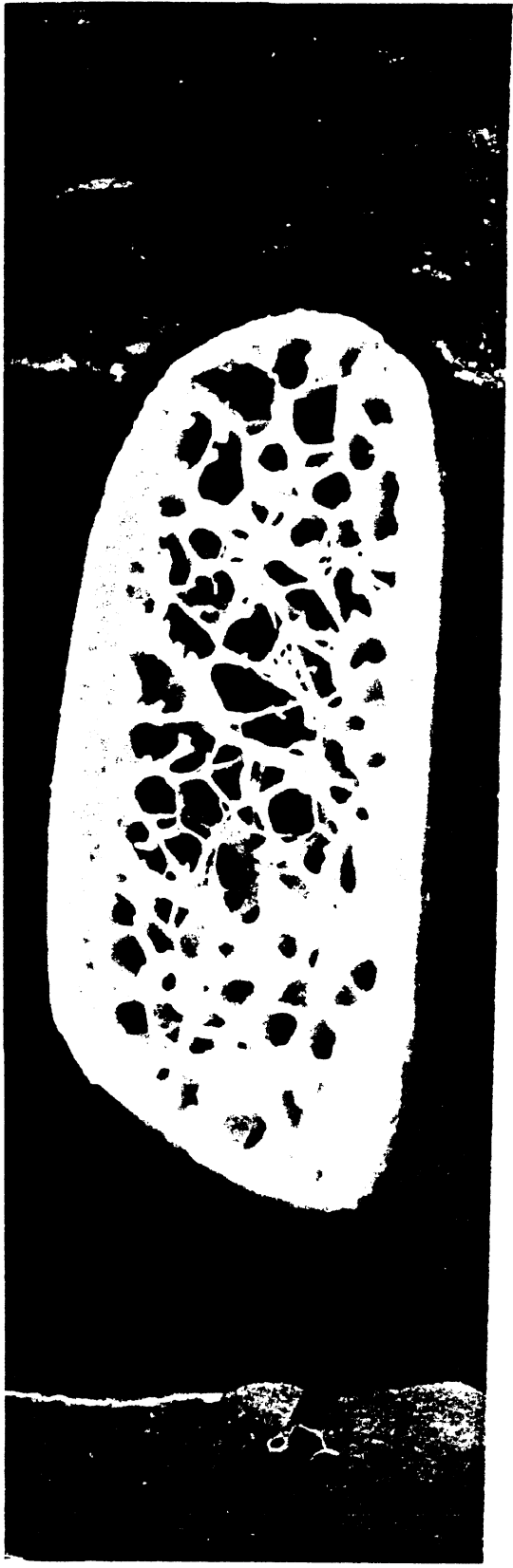
Subject 20777
Sample R-G

→ Motion ←
↑ 100% ↓

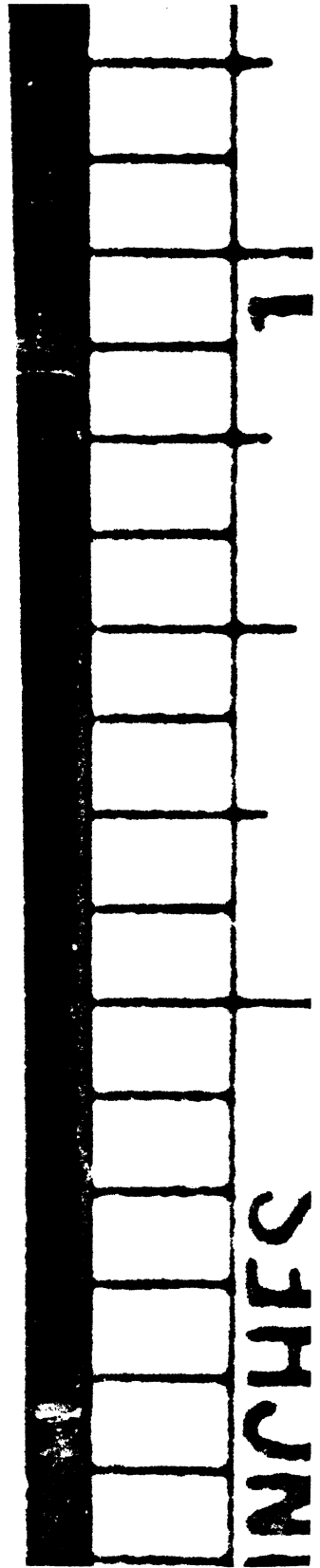
↑

8





207777 R6



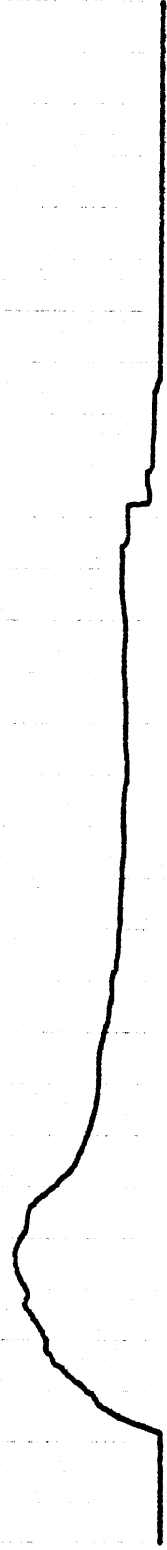
+ ↑

Subject
Sample

20788
R4

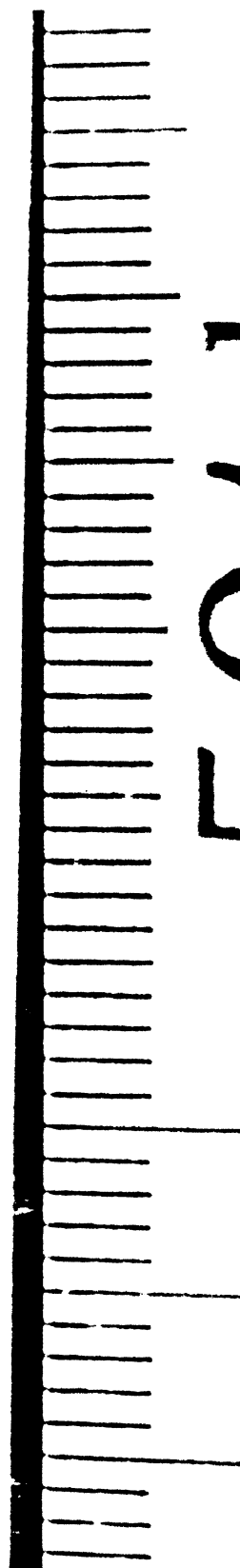
→ 1/3 inch ←

↓ 10# ↑





20788 RA



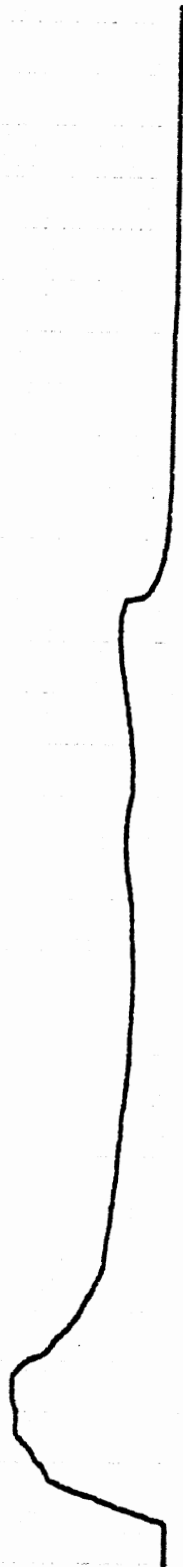
50ths

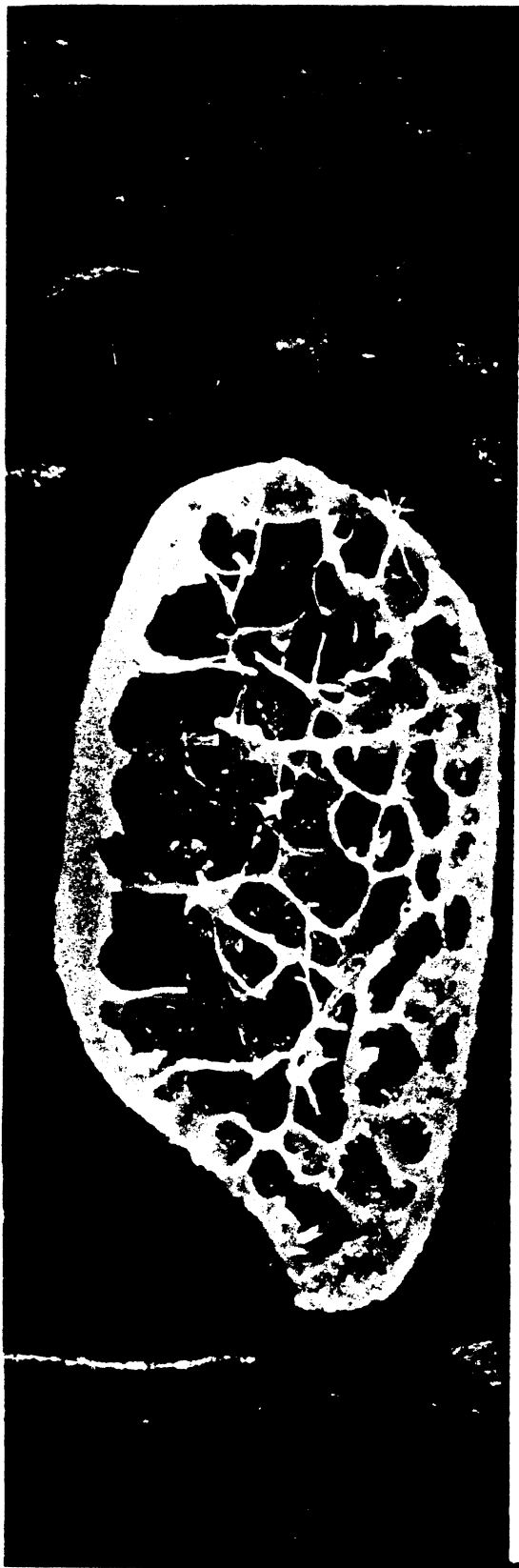
Subject 20788
Sample R5

↓ 10# ↓

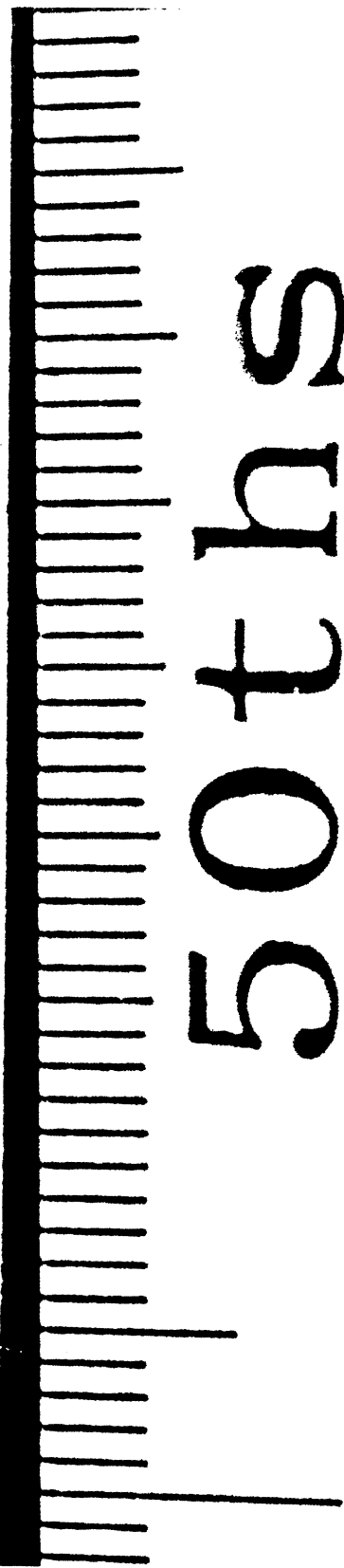
→ 1/3 inch ←

+ ↑





20788 R5



50ths

+ ↑

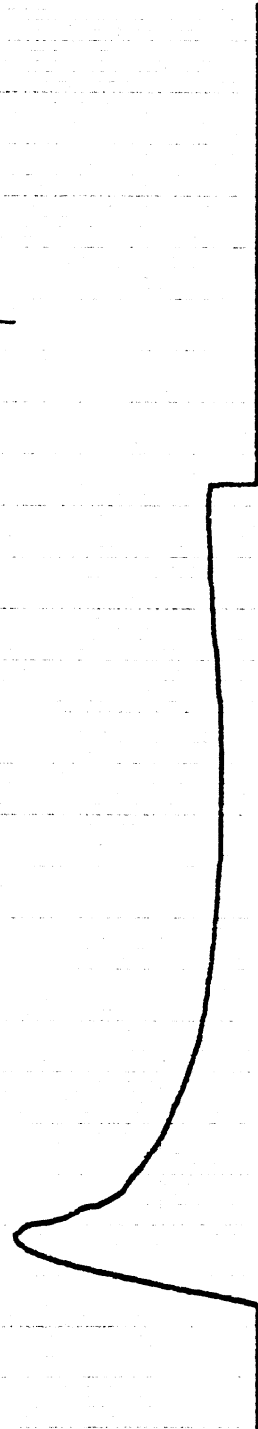
Subject
Sample

20788

R6

→ 1/3 inch ←

↓ 10# ↓





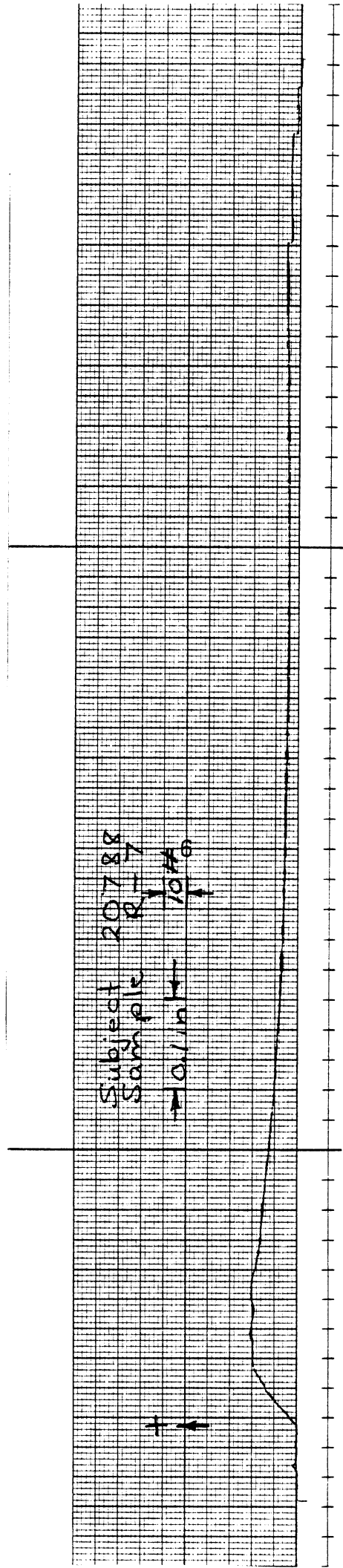
20788 RG

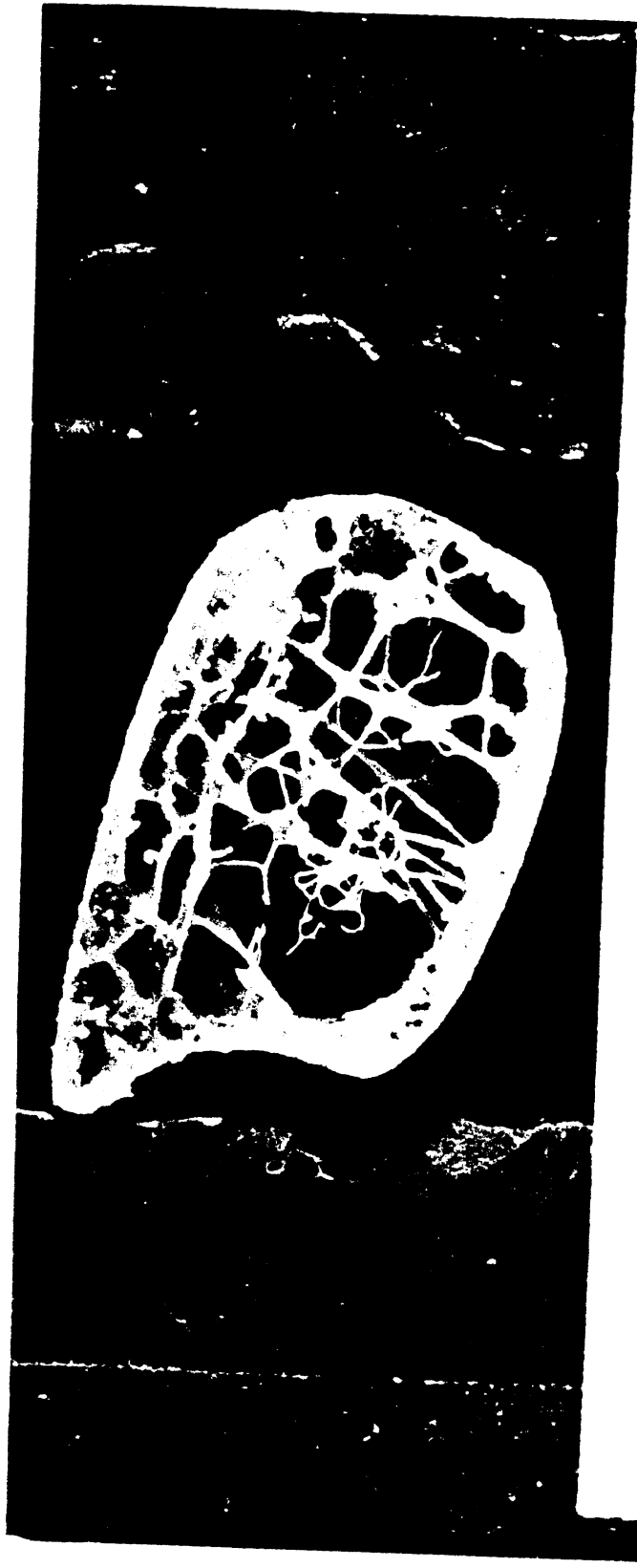


50 + 5 ~

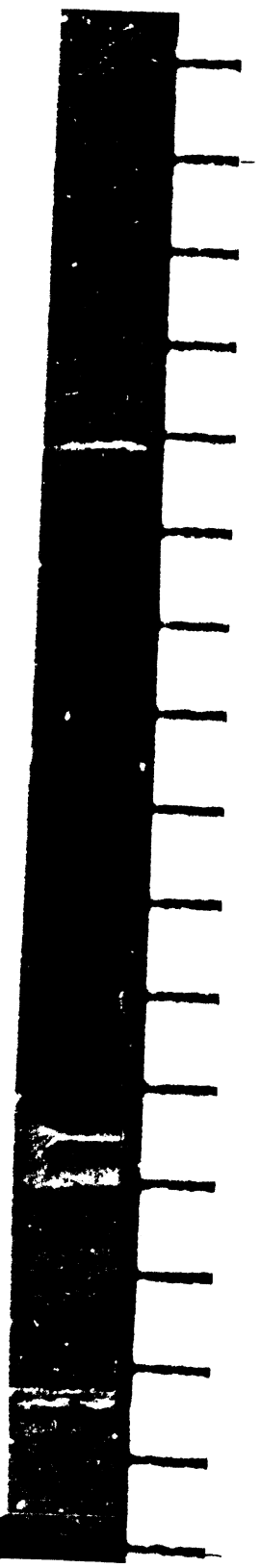
Subject 20788
Sample R-7
→ 0.116 ← 10 Hz

↑





20788 R7

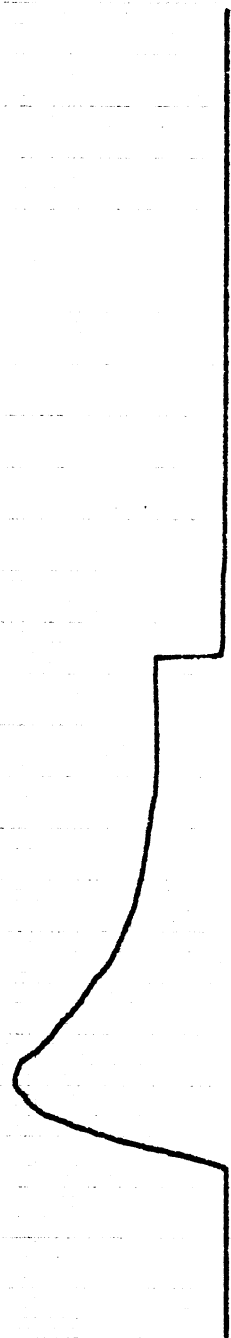


+ ↑

Subject 20800
Sample R6

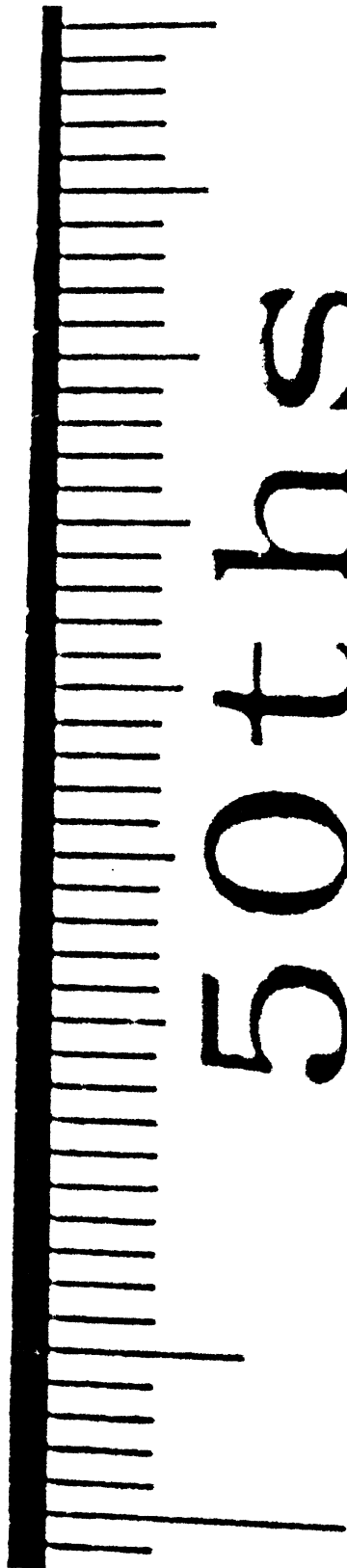
→ 1/3 inch ←

↓ 10# ↓





208000 R6



50ths

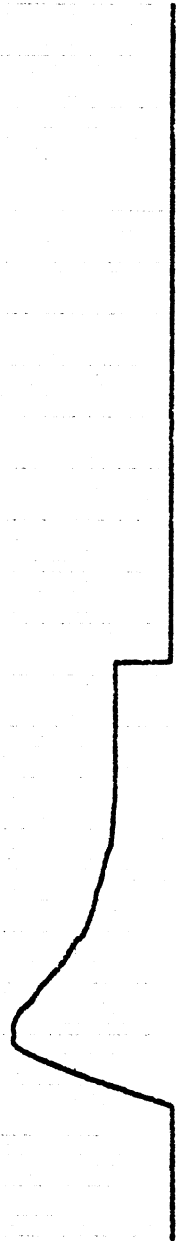
+ ↑

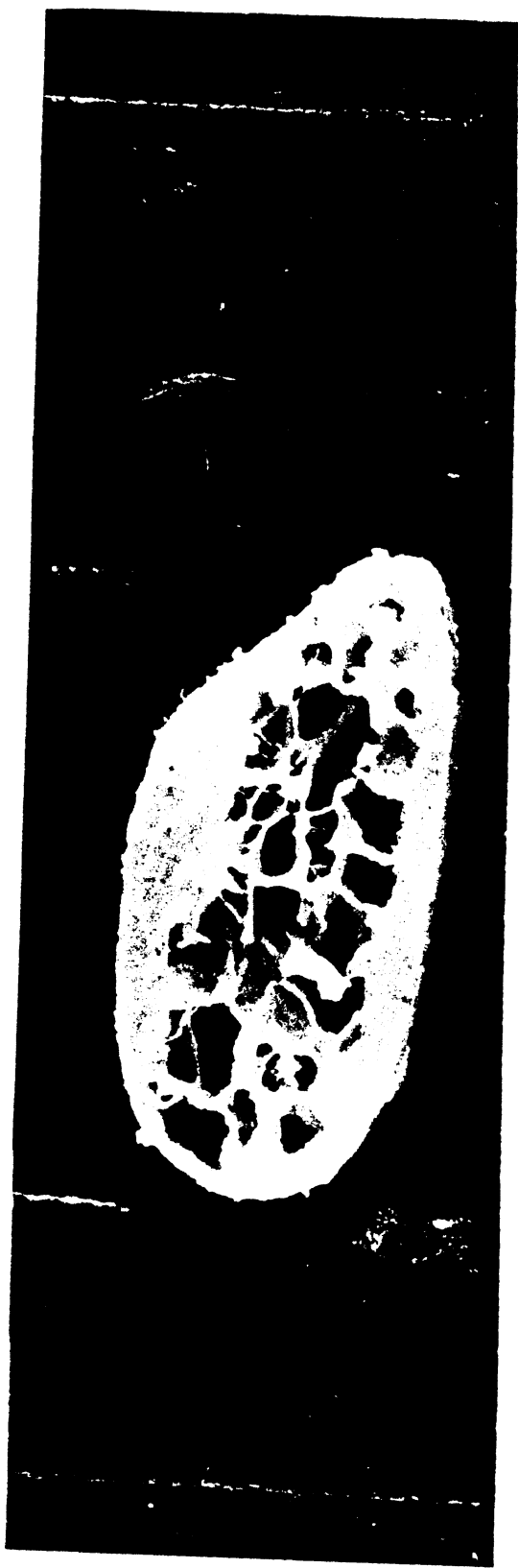
Subject
Sample

20800
R7

→ 1/3 inch ←

↓ 10# ↓





20800 R7



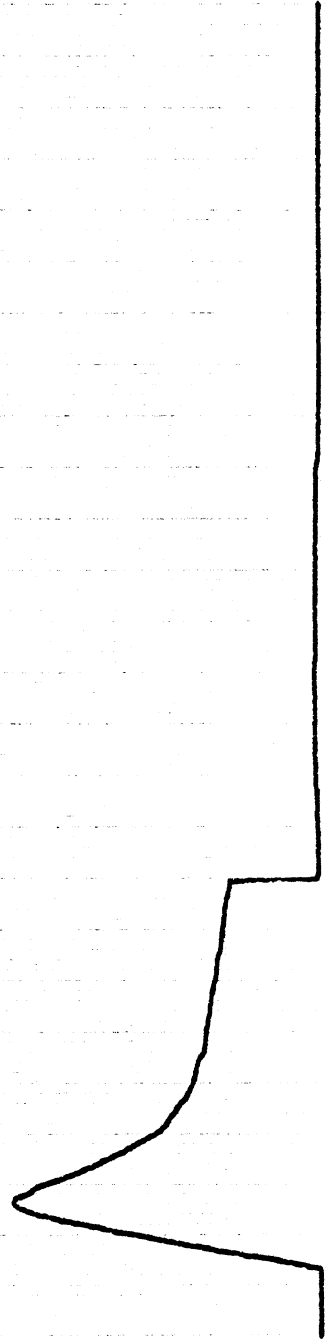
50ths

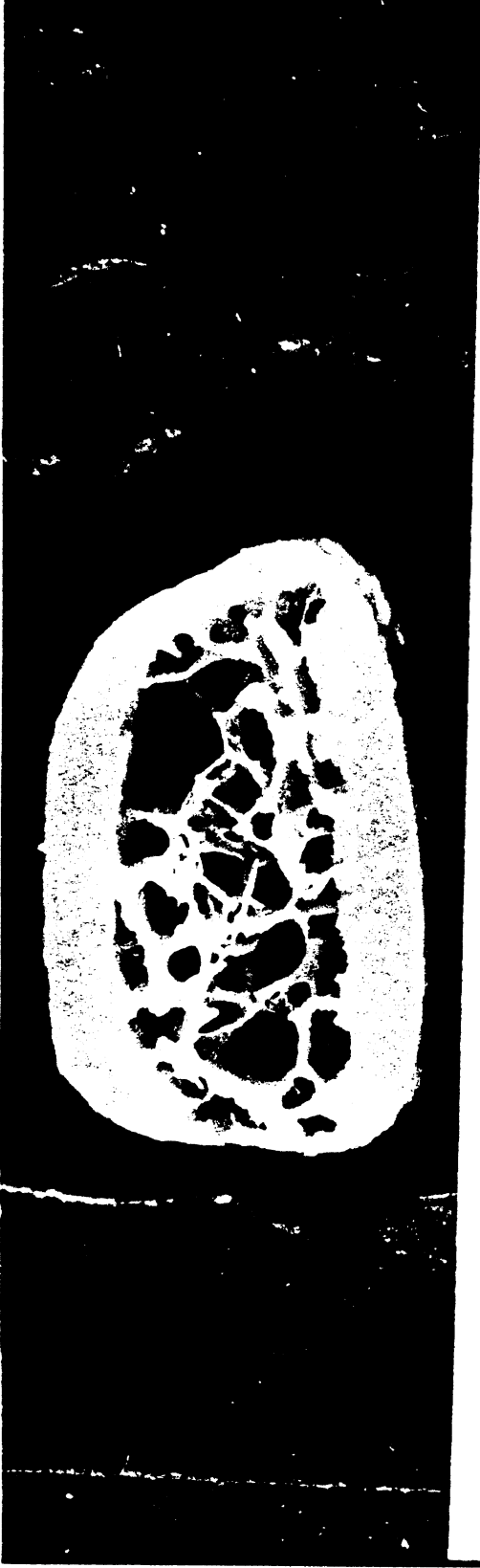
+ ↑

Subject 20800
Sample R8

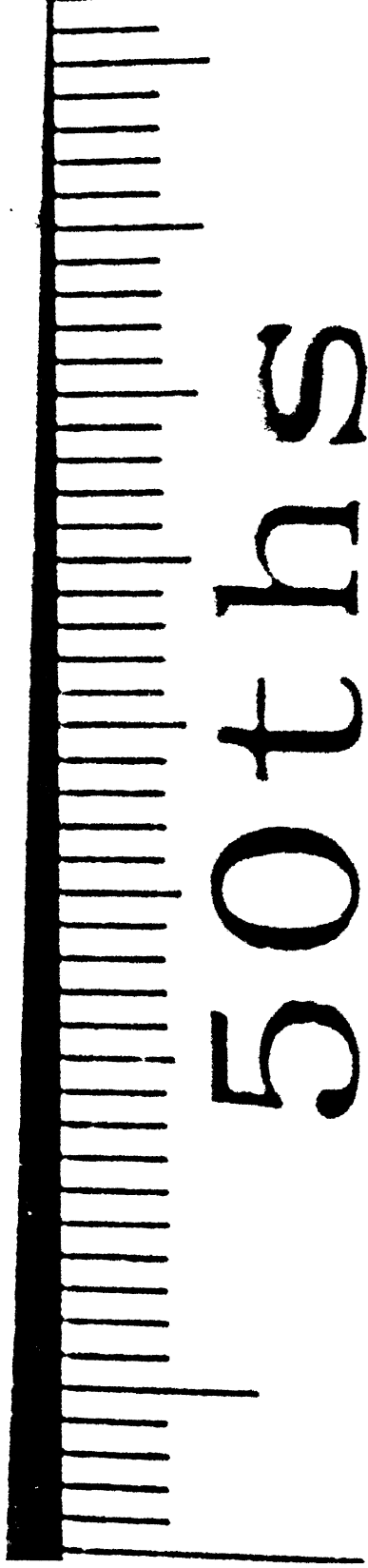
→ 1/3 inch ←

↓ 10# ↓





20800 R8



50ths

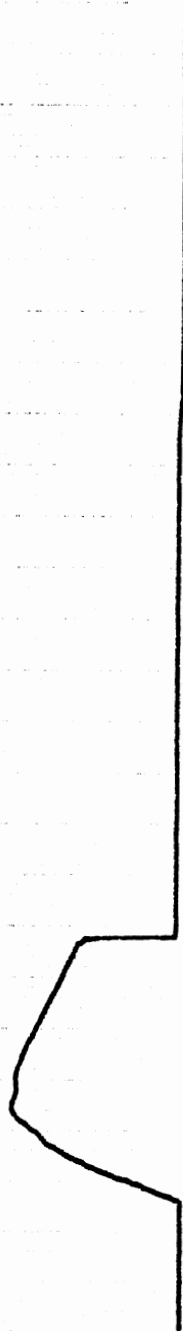
+ ↑

Subject
Sample

↑ 1/3 inch ↓

20806
L4

↑ 10# ↓





20806 I4



50ths

+ ↑

Subject
Sample

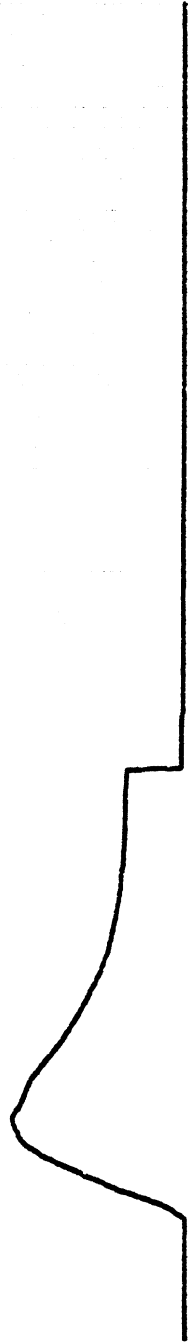
→ 1/3 inch ←

20806
L5

↓

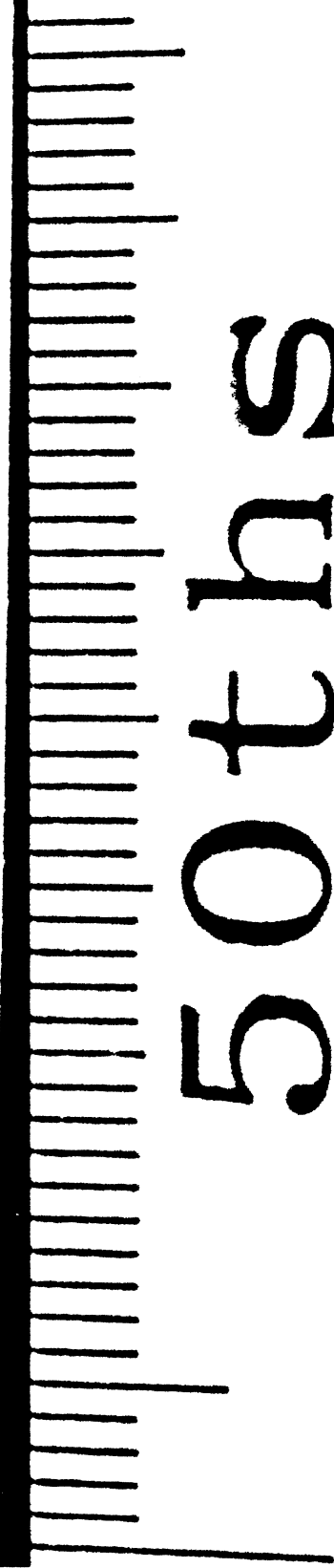
10#

↑





20806 I5



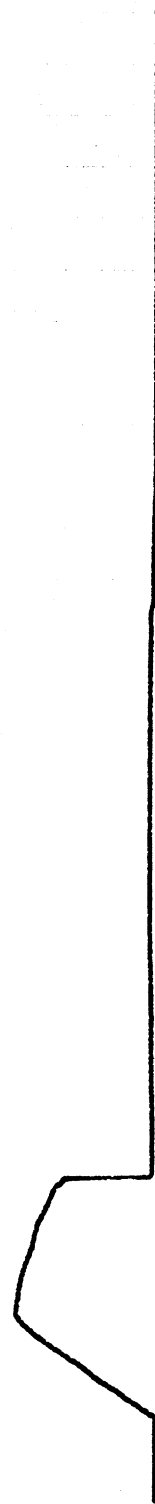
50ths

+ ↑

Subject 20806
Sample LG

→ 1/3 inch ←

↓ 10# ↓





20806 L6



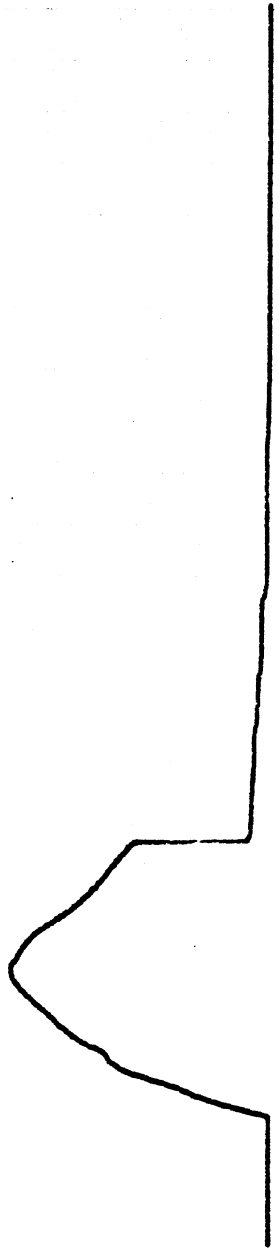
50ths

+ ↑

Subject 20818
Sample R4

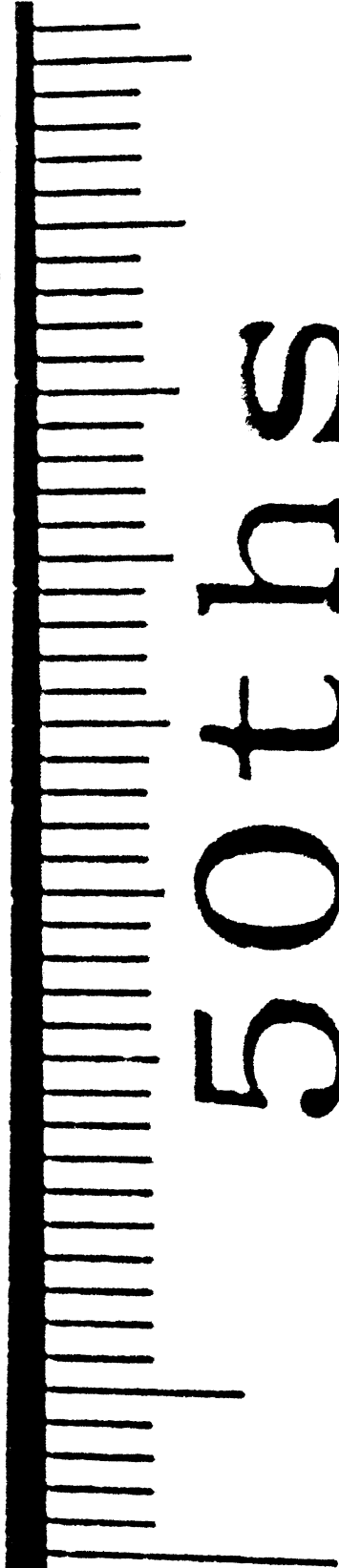
→ 1/3 inch ←

↓ 10# ↓





20818 R4



↑

Subject
Sample

→ 1/3 inch ←

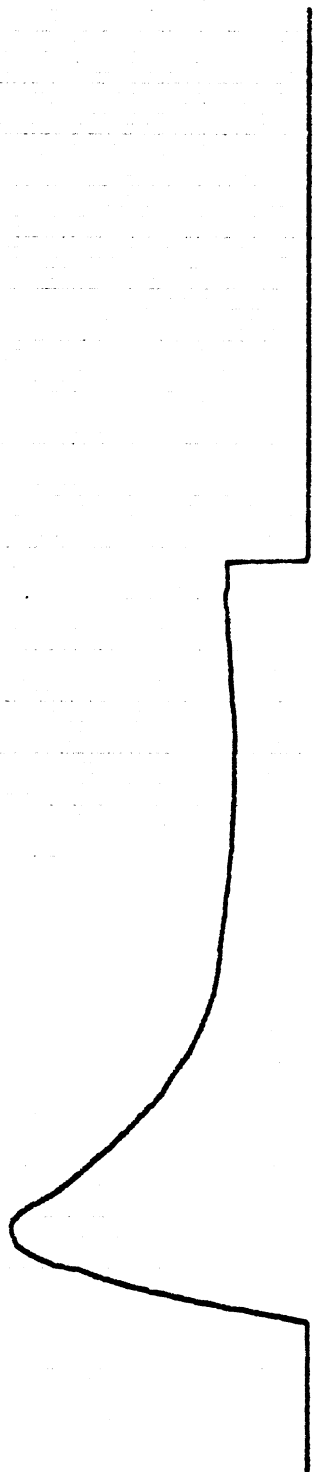
208/8

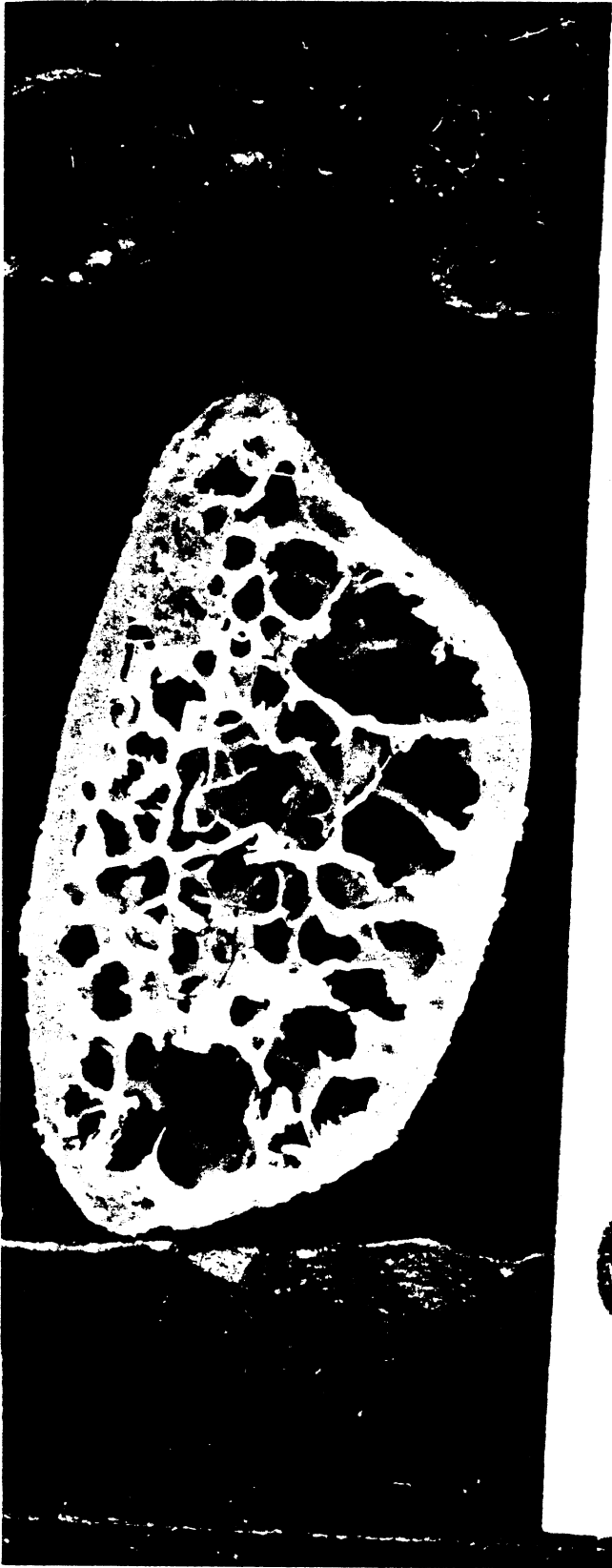
R5

↓

10#

↑





20818 R5

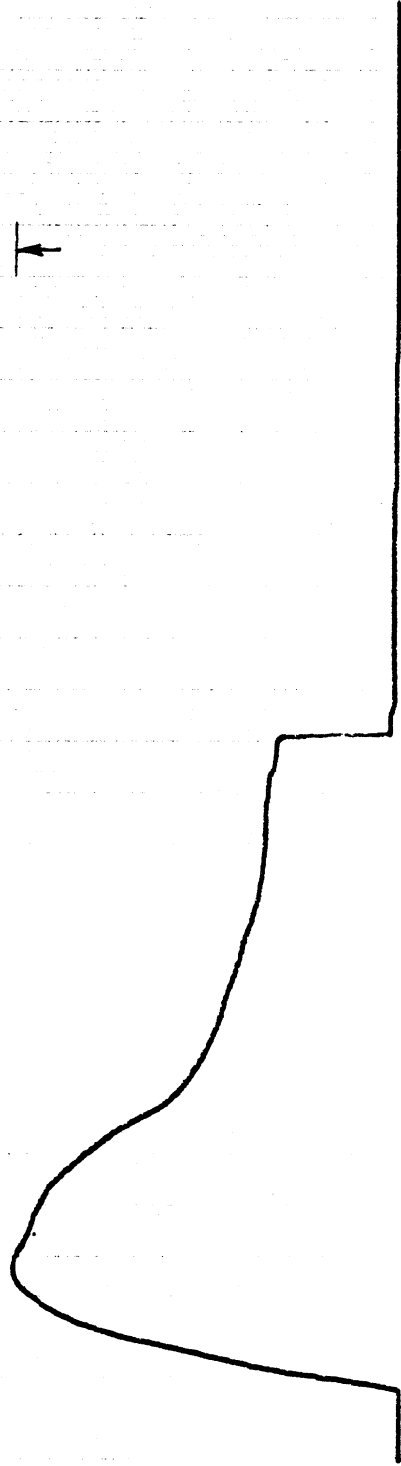


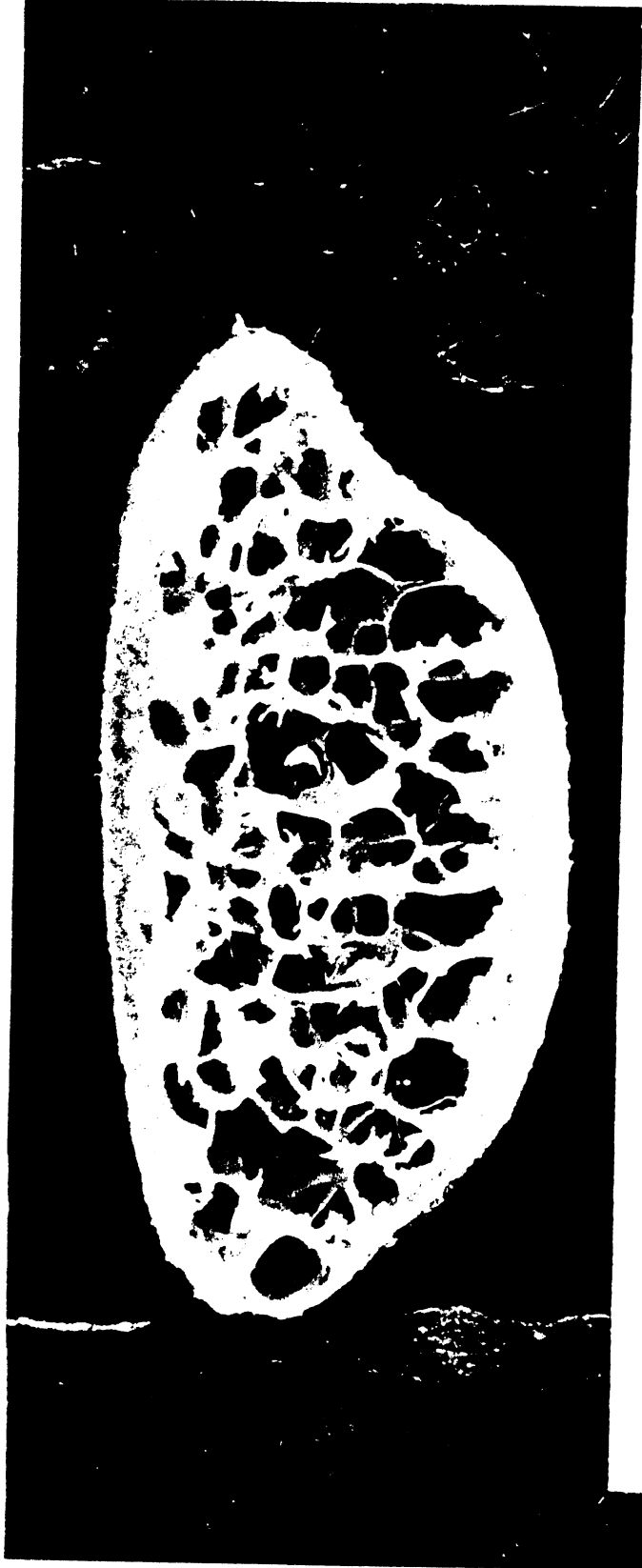
Subject 20818
Sample R6

↓ 10# ↑

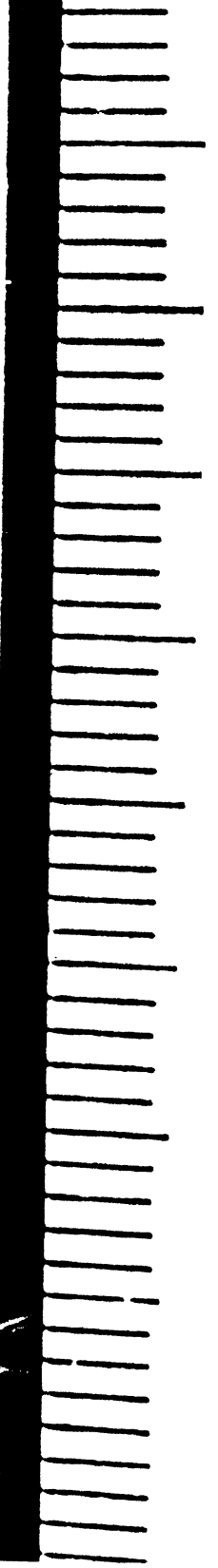
→ 1/3 inch ←

+ ↑





20818 R6

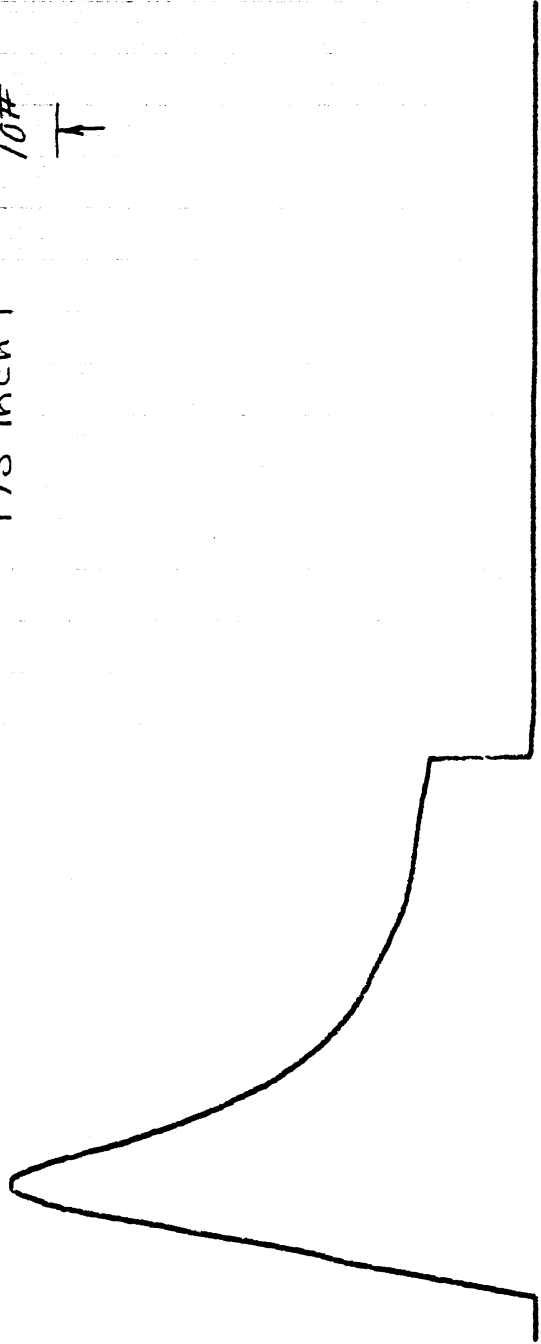


+ ↑

Subject 20818
Sample R7

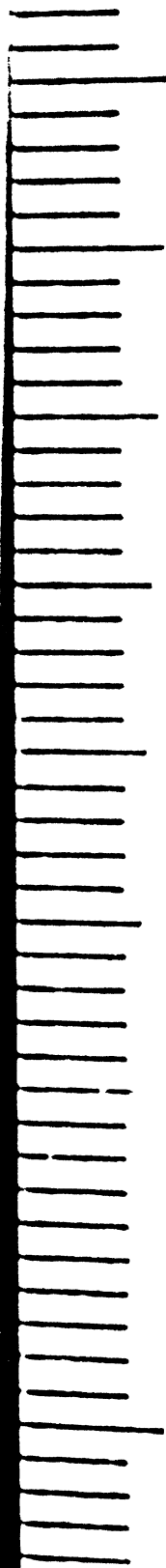
→ 1/3 inch ←

↓ 10# ↓





20818 R7

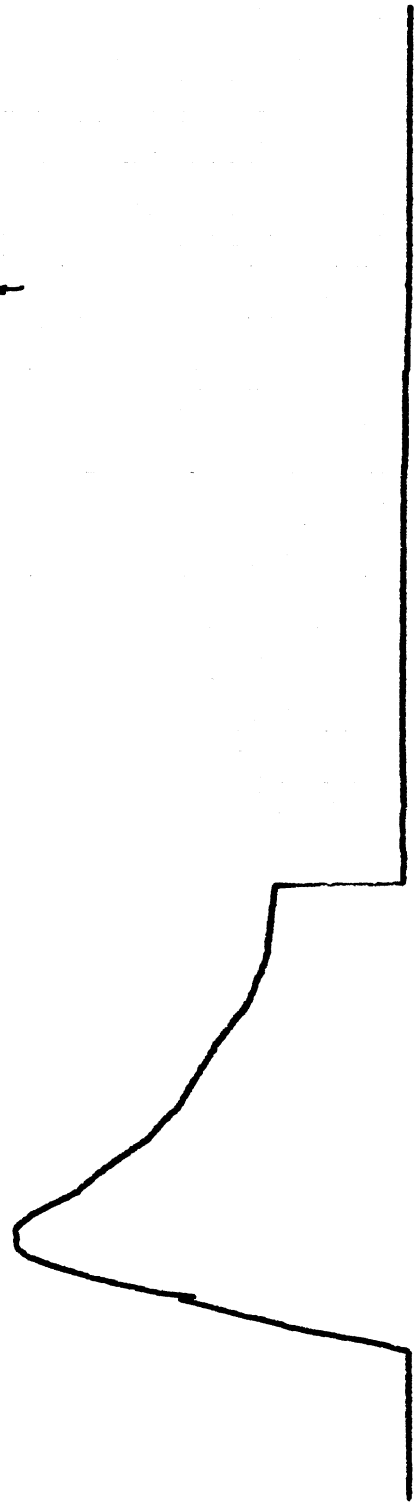


Subject 20822
Sample R6

→ 1/3 inch ←

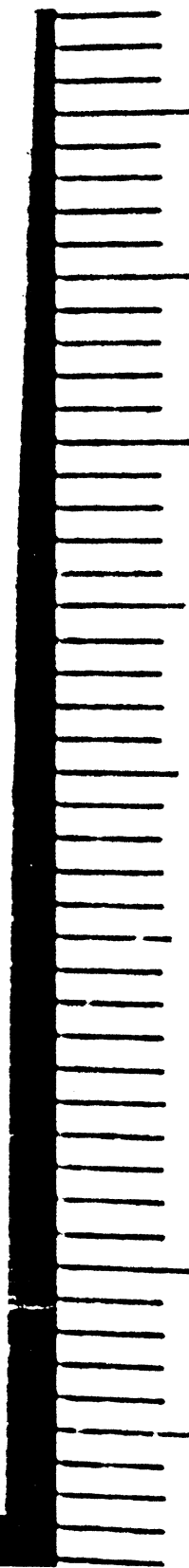
↓ 10# ↓

+ ↑





20822 R6

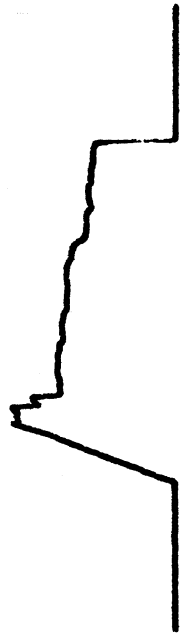


Subject 20822
Sample R7

→ 1/3 inch ←

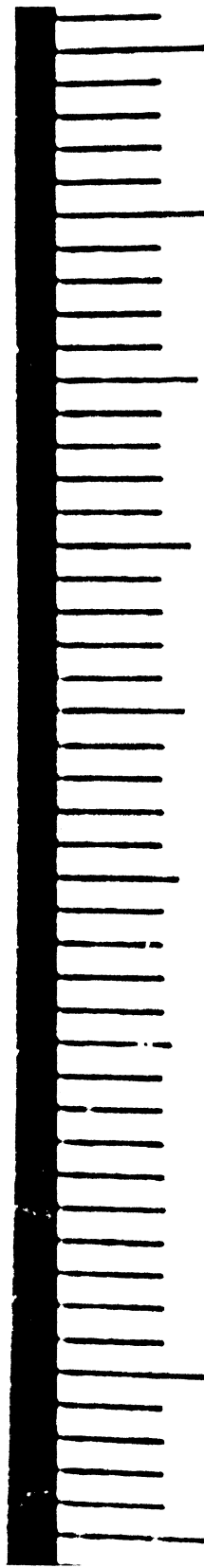
↓ 10# ↓

+ ↑





20822 R7

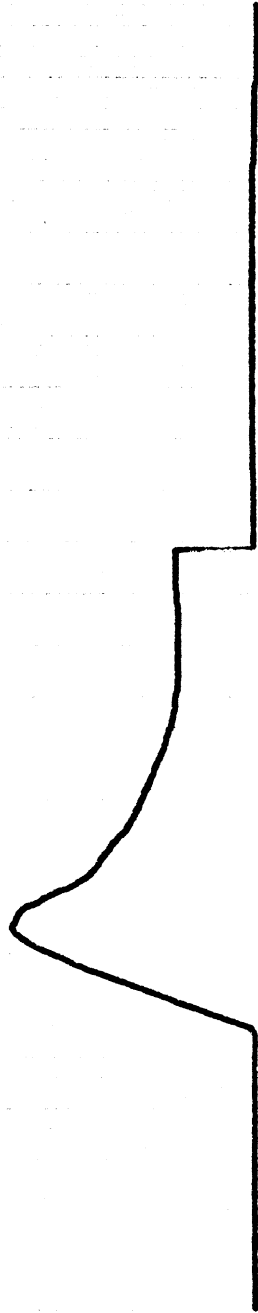


+ ↑

Subject 20822
Sample R8

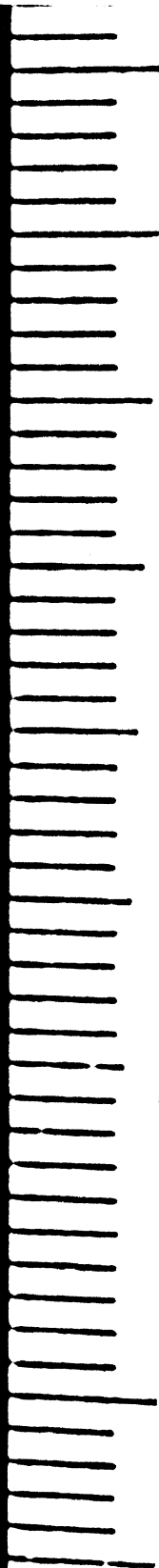
→ 1/3 inch ←

↓ 10# ↑





20822 R8

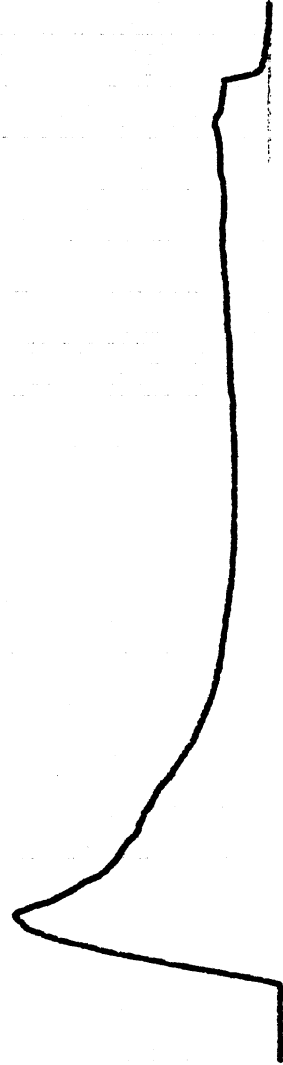


+ ↑

Subject 20837
Sample R5

→ 1/3 inch ←

↓ 10# ↓





20837 R5

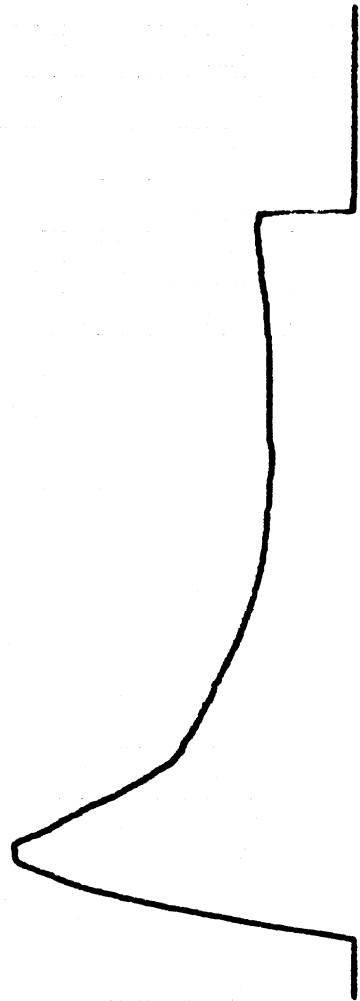


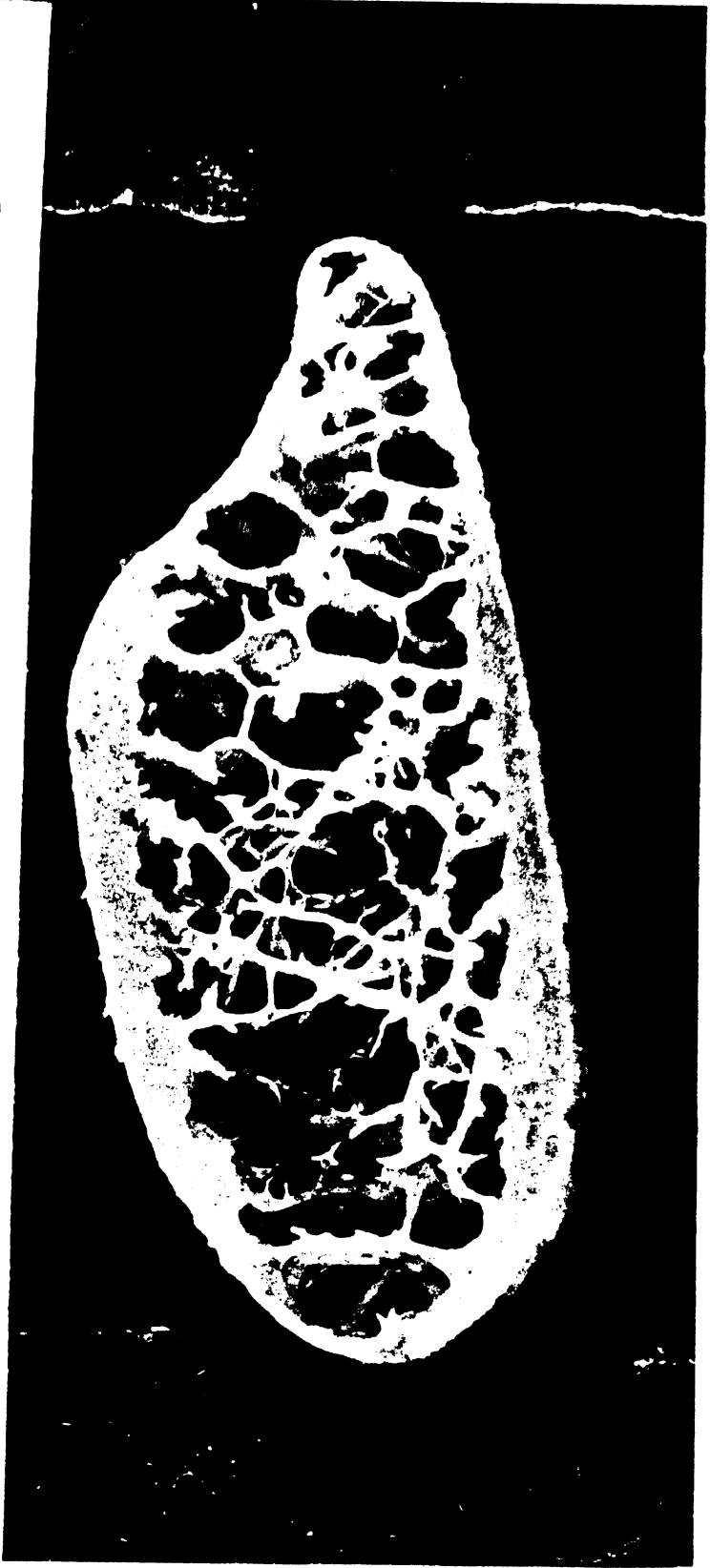
+ ↑

Subject 20837
Sample R6

→ 1/3 inch ←

↓ 10# ↓





20837 R6

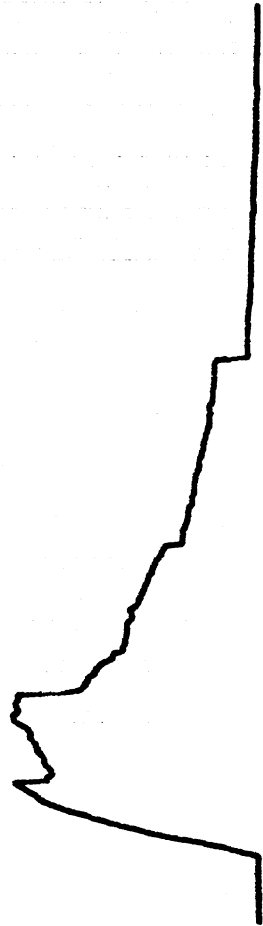


+ ↑

Subject 20837
Sample R7

→ 1/3 inch ←

↓ 10# ↓





20887 R7

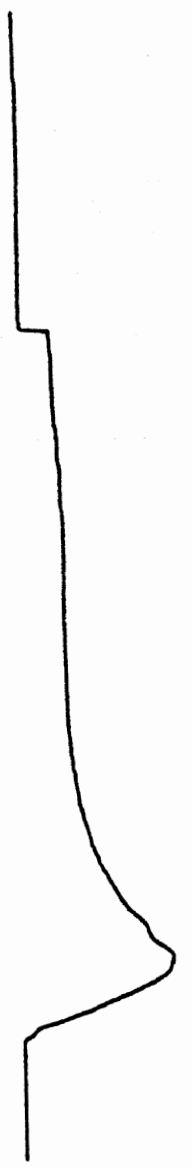


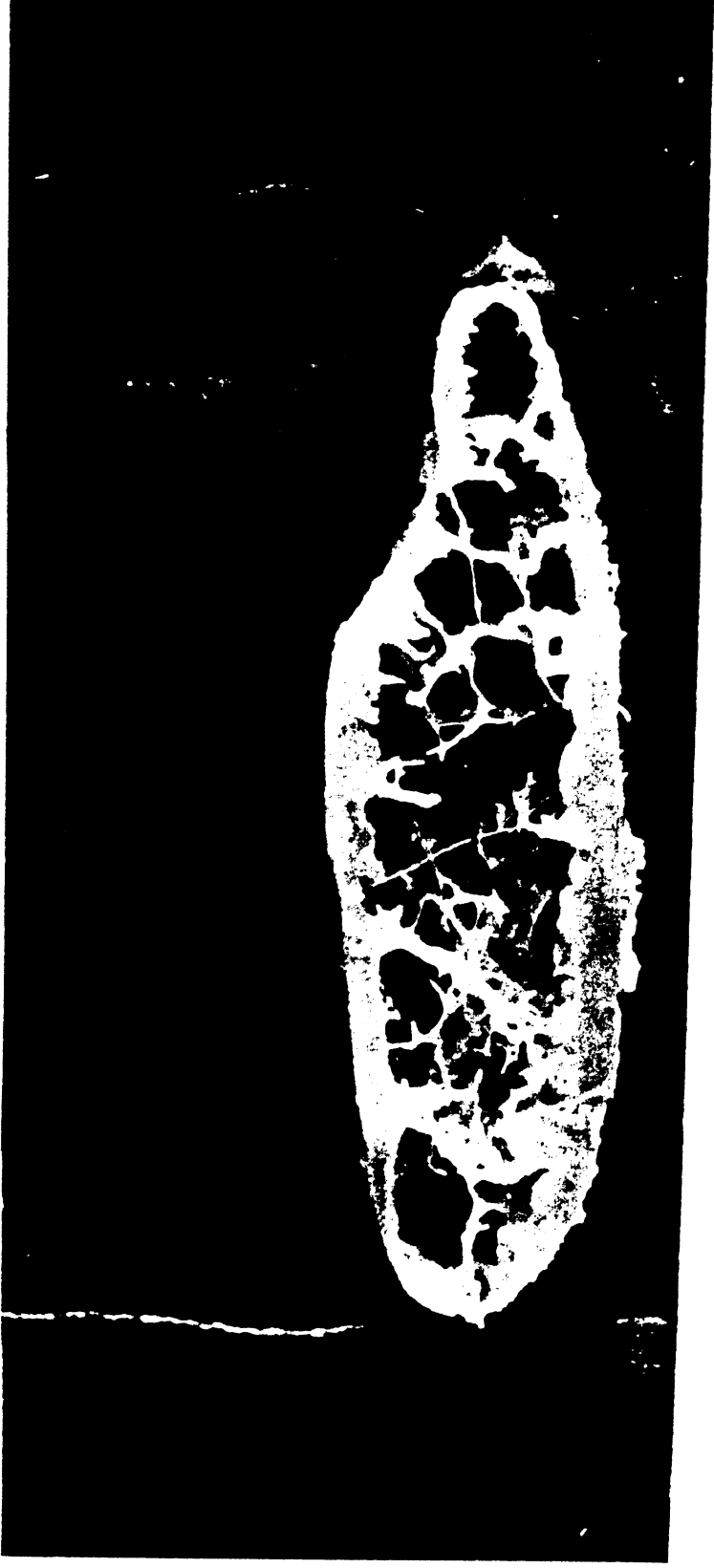
Subject 20853
Sample R5

↓ 10# ↓

→ 1/3 inch ←

→ +





20853 R5



Subject 20853
Sample RG

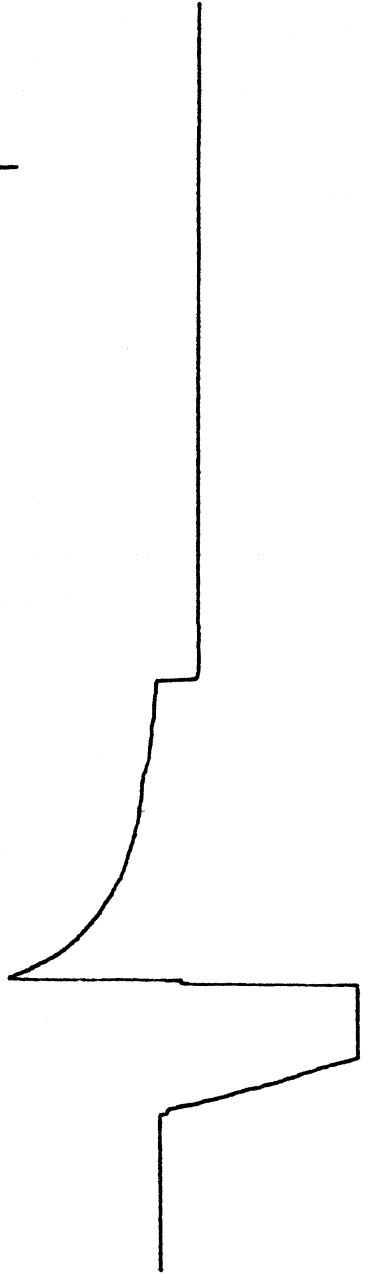
→ 1/3 inch ←

↓ 10# ↓

↓

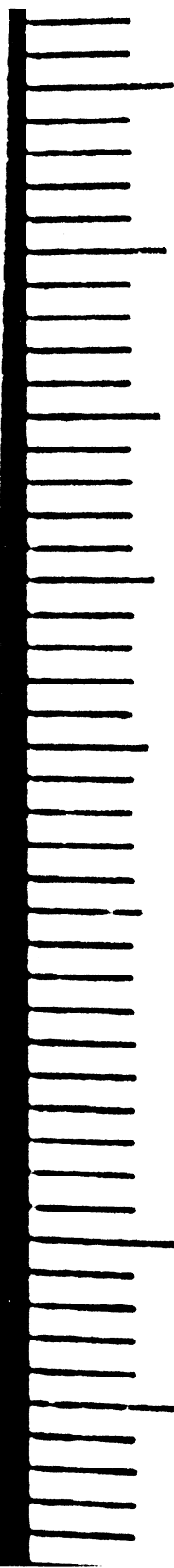
+ ↑

↓ +





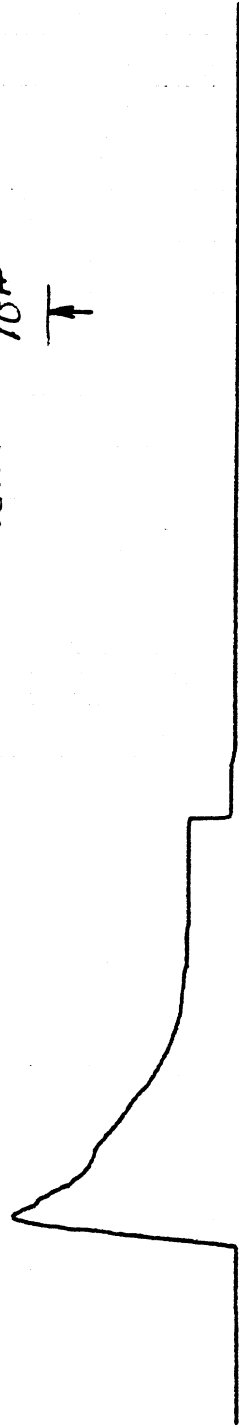
20853 R6



Subject 20853
Sample R7

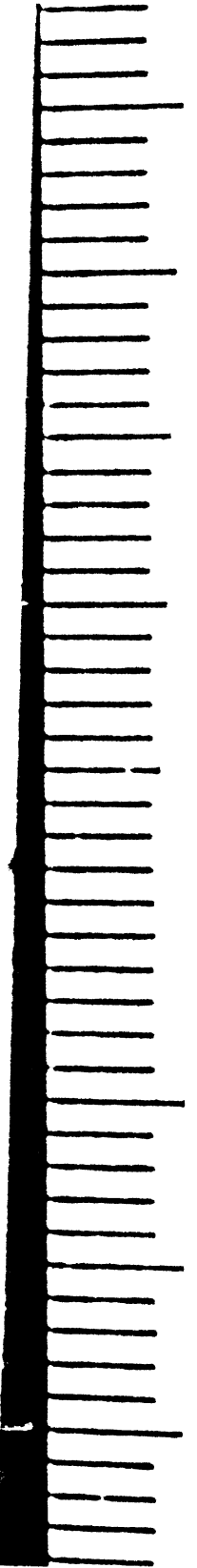
→ 1/3 inch |
↓ 10# ↓

+ ↑





20853 R7



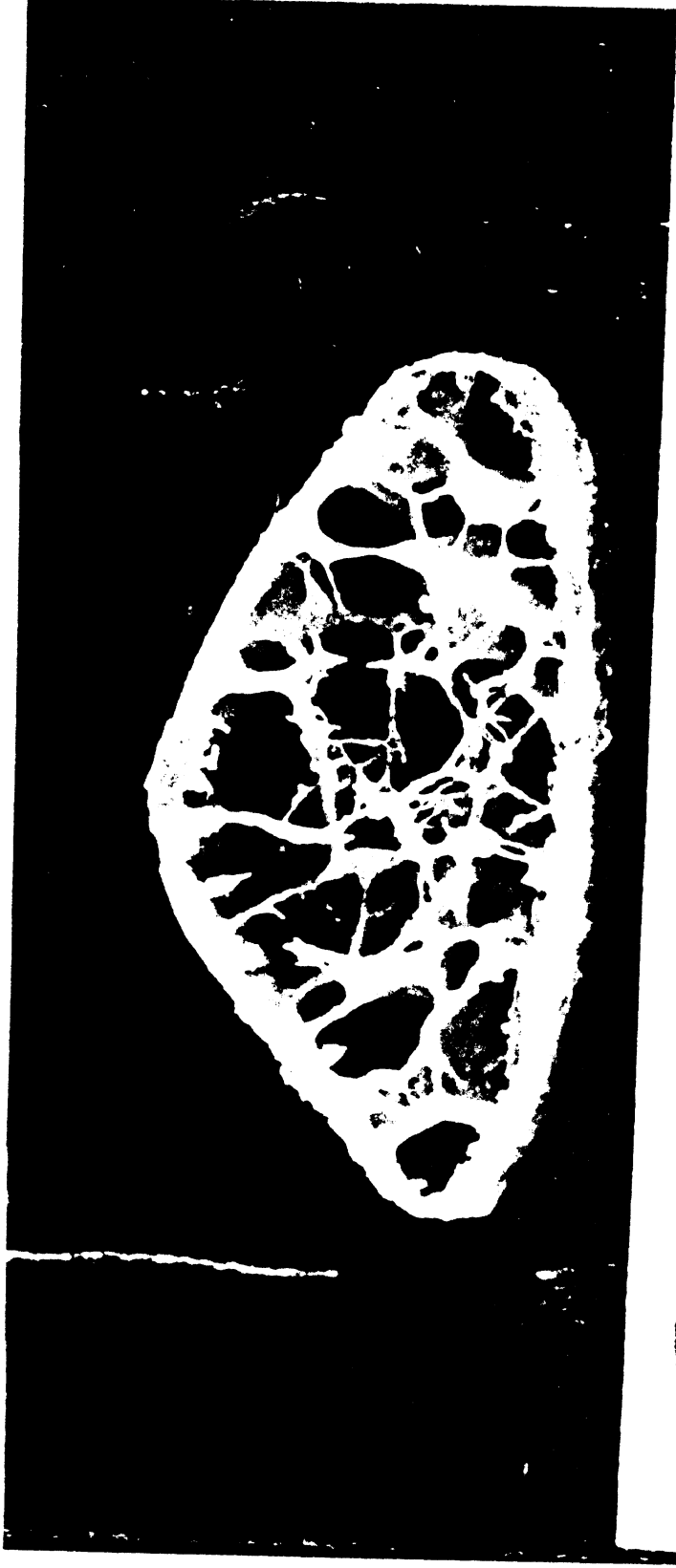
Subject 20853
Sample R8

→ 1/3 inch ←

↓ 10# ↓

+ ↑





20853 R8

