

M

D

A P C D B U U M
D R B T
M
L

!"#\$%&'()*
!"#\$%&'()*+,-./012,31,*450'2367/3%8329,.027:%23%7(%/-20%-48;><?%
!"#!%@(A(*B-C53%2/0/6:*8329,.027:%/E%F53050*H D
!"#!%@(A(*&0:1'/0/6:*8329,.027:%/E%F53050*H D %

+(, '&'(), * - ! . " *
!"!GH+/I % A00/1257, %) 2., 17/. *83J, .6.5J-57, %+ , -./012, 31, %&./6.5C*8KL %
!"!H+/I % A00207537%&./E, 00/.*%), M5.7C, 37%/E%2/0/6:*8329,.027:%/E%K, .C/37%
!"#\$H! "!!% &/07J/17/.50%N, 0, 5.1' %O, 00/I *P//0/6:*8329,.027:%/E%@.2720' %Q/0-CR25%
!"!H! "!!% &/07J/17/.50%>, 51' 236%O, 00/I *P//0/6:*8329,.027:%/E%@.2720' %Q/0-CR25%
!"#\$H! "#!% ;7-J, 37%N, 0, 5.1' %>, 1' 321253*%&' 5.C(%S%>/T(%8329,.027:%/E%F53050%
*

/#) " ') O*
!"#\$%&'(")%*+,'
!"!UH! "!"\$% +; 0%@NQH@VW*%XA a a a a a D
M a a &.2312M50W39, 072657/. *YUUU*G! Z%
-\$. \$%&/0'1"23*&\$)\$'4#54516/1,'
!"!U% +VBHN" #*%V30-023%53J%01 , , 7%7507, [%C, 1' 5320C0%/E%C, 75R/021H6-0757/.: %
237, 6.572/3\%&.2312M50W39, 072657/. *Y#*#\$]" "" "" %M, 3J236%, 92, I ?%
!"!U% 4' 27, ' 500%O/-3J572/3*%XI a a a
a &.2312M50W39, 072657/. *YG" "" "" "" %3/7%6.537, J?%
!"!G% 4' 27, ' 500%O/-3J572/3*%XC a a a U S T a C
D a &.2312M50W39, 072657/. *YG" "" "" "" %3/7%6.537, J?%
!"!G% L 500231^./J7%O/-3J572/3*%XI a

](, 234567:*8(*a' /0' *@(%4 , 200*PO(*Q' .20725530, *e(%a/.J/3*L) (%! " ! #?(%
L , 1' 5320C0%/E%6-0757/.. :%051721%512J%577.5172/3%23%D a(%C B G#*%
#H#G(%

=1/37.2R-72/3%#" " g?) WV[#"(#" #Zm(1-R(! " ! #(" Z(" " "]%

Z(e5, 6, .%AB(c**, 234567:*89;:*4 , 200*PO(*L -00/*&Hj (*Q' 53*NQ4 (*P' 536*B(*%
0, DJC53HF200*) (*a/.J/3*L) (%! " # i ?(%A%1/CMD, T%M, .2M' , .5D%1/J, %E/.%05D7%7507, %23%
D a(% L \$[, G\$#Z\$(% a a ?%

=1/37.2R-72/3%\$] g?) WV[#"\$]Uh, <2E, (G\$#Z\$%

\$(A3J., I *%Ne(c*O, .353J, f%Qa(c*%, 234567:*8(*%2536*B(*%+6-: , 3*%&(*N21, *%NQ(*%
@-6625H&., 9/7*K(*% , %N/002*%&(*%K, 7.29, D*F; (*%-5CR*N(*%A.6, CZ*A(*%N57' R-3*%_(*%
F.5-0, *% (*^ -*a(*%4563, . *% <(*%&5., 37*A>(*B/07fC53*) L (*%>' 235^5.53*a(%! " #\$(%
<51^%/E@AQ_#%; HM5DC27: D572/3%, J-1, 0%5C: D/2J%R-.J, 3%53J%C272657, 0%C, C/.: %
J, E21270%23%7.5306, 321%C/-0, %C/J, D%/E%AdF' , 2C, .10%J20, 50, (%PNAS ##U=U]?[_bZZ]H
\$U(%1/37.2R-72/3%G" g?

=1/37.2R-72/3%\$ " g?) WV[#"\$! heQV\$b\$U! %
%
#G(L -.5: *%L (*% 234567:*89%<-65. *%BL (*%B, .0' , : *%>(%#! " #G?(%B2MM/15CM509/D-C, %23%
7: M, %%%J25R, 7, 0(%US E b=! ?[b#HU(%
=1/37.2R-72/3%]g?) WV[#"\$! h (! " #U("#" "#(U%
%
7"2*1=\$)! 533\$%&6#\$1=%
#U(, 234567:*89%L 1) /I , 00%: A>(*%a/.J/3*%L) (%! " !"?(%A%ED: %' /J/M0230' , J0%026' 7%/3%
7' , .C50%7507, (% Ca b#[#"!!]b(%
=1/37.2R-72/3%b" g?) WV[#"\$! "# #Zm(1, 15(! " ! "#"!!]b%
%
&! %\$- ') O*
! \$#&(*. 6&\$1,'
! "#b[QVN><%&.517272/3, .%8329, .027: %/E%@.2720' %Q/D-CR25*%&/07J/1%>, 51' 236%W37, .30' 2M%
! "#\$[QVN><%A00/1257, %4 50' 2367/3%8329, .027: %23%: 7(%<-20%>, 51' 236%Q, 37, .%&./6.5C'
>\$: '! 5"#1\$1'?\$8\$/54\$),'
! " ! G% @VW<% " U%AJ9531, J%a, 3, 7210%<5R%Q/- .0, HR50, J%83J, .6.5J-57, %N, 0, 5.1' %
TM, .2, 31, %Q8N?%8KL %
! " ! G% @VW<%G\$#@%a, 3, 721%>/D0%23%+, -. /012, 31, %6.5J-57, %D, C235.?%8KL %
! 5"#1\$1'&6" +=&'6&'&=\$@%*8\$#1*&0'5('A\$#35%&,'
+; QV%# " " %_TMD/.236%+, -. /012, 31, %q%<5R%Q//.J2357/. *%0500%\$% M.236% " ! UH! " !] %
+; QV%# " " h! # "] *_TMD/.236%+, -. /012, 31, %I 27' %) .(%A351^, .?%0500% " ! G%
@VW<% " UhUZG" *%AJ9531, J%a, 3, 7210%<5R%Q8N_?% M.236% " ! G*% " ! U%
@VW<%G\$#@%a, 3, 721%>/D0%23%+, -. /012, 31, % M.236% " ! G%
7#\$8*5"1! 5"#1\$1*
! " ! ! % % @VW<%G\$#%&.2312MD, 0%/E%+, -. /R2/D/6: %#%8329, .027: %/E%@.2720' %Q/D-CR25%
! "#Z% % @VW<%UbGG%L /D, 1-05.%@2/D/6: %57%7' , %Q-77236%_J6, *%4 8; ><%
B"\$1&'C\$. &"#\$1,'
! " ! GH! " ! U% +; QV%# G" H%02.07H: , 5.%+, -. /012, 31, % , C235.%
! " ! G% % @VW<% " bZH%<2E, %; 12, 31, 0%Q8N_%<5R%
! " ! G% % @VW<% " G" %02.07H: , 5.%@2/D/6: %; , C235.%
! " ! ! % % QB_L %#! #%<-537275729, %A35D: 020*%8329, .027: %/E%K, .C/37%
! " ! #% % QWa; %J" #%Q/632729, %; : 07, C0*%8329, .027: %/E%@.2720' %Q/D-CR25'
! "#bH! " ! #% ; 12, 31, %# " #%/ -7. , 51' %1/ - .0, ?%8329, .027: %/E%@.2720' %Q/D-CR25'
! "#b% % @VW<% Z" %0-3J5C, 37500%/E%&' : 02/D/6: *%8329, .027: %/E%@.2720' %Q/D-CR25%
! "#\$H! " #i % @VW<%J]] %Q/CM5.5729, %+, -. /R2/D/6: *%8329, .027: %/E%@.2720' %Q/D-CR25%
! "#]H! " # \$ % @VW<%UbGG%L /D, 1-05.%@2/D/6: %57%7' , %Q-77236%_J6, *%4 8; ><% %
! "#] % % +, -. /012, 31, % -CC, .%Q/- .0, %&.2/ .: %B26' %; 1' /D% 7(%<-20%L W
D\$6. =*%+'E11*1&6%&=%
! "#G% % @VW<%J" U%<5R/.57/ .: %/E%+, -. /M' : 02/D/6: *%4 8; ><
! "#%#% % @VW<%# " #! %a, 3, .50%@2/D/6: %<5R%E/.%+ /3HL 5m/.0*%8329, .027: %/E%F53050

@%)\$##6)"6&\$'D#6*\$'\$1'6&'@AF'

!""]H+/I % _CC2% 7-.C%+; QV%1., J270?%
!""]H+/I % L 5J20/3%L 1Q-23%+; QV%1., J270?%
!""]H+/I % e-025%+, , E, %+; QV%1., J270?%
!"" UH+/I % ;/E25%&-112/%@VW<%1., J270?%
!"" UH+/I % A95%K277, .0%@VW<%1., J270?%
!"" UH+/I % ; 5C537' 5%a2RR/30%@VW<%1., J270?%
!"" UH+/I % _005%0., , J%+; -CC, .%N, 0, 5.1' %AI 5.J*%+; QV%1., J270?%
!"" UH+/I % L 5T%>, ..51253/%+; QV%1., J270?%
!"" U% % >-1^, .%A9/3J5%@VW<%1., J270?%
!"" GH+/I % <-^, %&./-J%1/HC, 37/., J% 27' %) .(%+ -3, f%@VW<%1., J270*%B/3/.0%>' , 020?%
!"" GH+/I % e5^, %a., 3/3%+; QV%1., J270*% -CC, .%, 0, 5.1' %50/1257, ?%
!"" GH+/I % <23J0, :%_5.0, %+; QV%1., J270*% -CC, .%, 0, 5.1' %500/1257, *%B/3/.0%>' , 020?%
!"" GH! ""! U% L 51: %W36, .0/00%+; -CC, .%N, 0, 5.1' %AI 5.J*%@VW<%1., J270?%
!"" GH! ""! U% a.51, %) 5920%+; -CC, .%, 0, 5.1' %500/1257, *%+; QV%1., J270*%B/3/.0%>' , 020?%
!"" G% % e, 00215%Q, .326025%+; -CC, .%, 0, 5.1' %500/1257, ?%
!"" G% % 4 200%>-.3, .%+; QV%1., J270?%
!"" ! H! ""! G% ; 5C: % 05C532%@VW<%1., J270?%
!"" ! H! ""! G% <25C%F, 002', .%@VW<%1., J270?%

B#6)"6&\$'D#6*\$'\$1'6&'@AF'

!"" UH+/I % >: 353%a51: *%+, -. /012, 31, %a.5J-57, %&./6.5C*%&') %07-J, 37%
!"" GH+/I % e5n-, 023, %a-200, C23*%@2/0/6: %a.5J-57, %&./6.5C*%&') %Q53J2J57, %
!"" ! H+/I % Q' .207253%A.370, 3*%+, -. /012, 31, %a.5J-57, %&./6.5C*%&') %Q53J2J57, %

D=\$1*1! 533*\$\$1'6&'@AF'%

!"" U% %) /053*_J-1572/350%<, 5J, .0' 2M%S%&/021: % 7-J2, 0%&') %&) , E, 30, %Q' 52.7%
!"" GH+/I %) 53%&, 2M, .7*%+, -. /012, 31, %&') %
!"" ! H! ""! U% Q5./023, %) -C50*%@2/0/6: %&') %
%

, !>?'\$! **

C%&=\$'H*5/5+0'?\$46#&3\$%&'6&'@AF%

!"" UH! ""!]% <, 17-., .%0, 5.1' %1/CC277, , %C, CR, .%@2/0/6: [%+, -. /012, 31, ?%
!"" GH! ""! U% >, 3-., H7.51^%E51-07: %0, 5.1' %1/CC277, , %C, CR, .%1, 00%R2/0/6: h3, -. /012, 31, ?%
!"" ! H+/I % @2/0/6: %) , M5.7C, 37%Q/CC-321572/30%S% 12Q/CC%W37, .30' 2M%1., 57/.%

E.#511')\$46#&3\$%&11.5//\$+\$1'6&'@AF%

!"" GH+/I % A00/1257, %) 2., 17/.%83J, .6.5J-57, %+, -. /012, 31, %&./6.5C*%8KL %

E.#511'A\$#35%&&

!"" GH+/I % K, .C/37% /12, 7: %E/.%+, -. /012, 31, %&

L, CR, .0' 2M %a, 3, 7210% /12, 7: %/E%AC, .215*% /12, 7: %E/.%+, -. /012, 31, *%051-07: %E/.%
83J, .6.5J-57, %+, -. /012, 31, %

7#\$8*5''1'1\$#8*.\$'61'6'*%\$\$'91\$/\$.&.

!"#iH! "!!% K&%023531, *% T, 1-729, %C, CR, .%&/07J/17/.50%A00/12572/3*%8@Q%
!"#ZH! "#\$% L, 37/. *%+VB%@D-, M.237H_+) 8N_% 7(%</-20%+, -. /012, 31, %&2M, 023, %
!"#GH! "#\$% Q/H&., 02J, 37*% T, 1-729, %C, CR, .%W8>6.5J0*%4 8; ><%
!"#JH! "#\$% &./6.5C%51002757/. *% 5E, P/3, 0*%4 8; ><%

%

, ! 8') %>, *%+>+!, !) &%&' () , %

6%8*&\$)'D6/K1,'

XA a a a a D a a a
8KL %+, -. /0/62150% 12, 31, 0*% , C235. *%@-. 02367/3*%K>*% ! ! U%
XA a a b a D a a a
L 2JJD, R-.: %Q/00, 6, *% , C235. *%L 2JJD, R-.: *%K>*% ! ! G%
C a a a b a D a a a
+, -. /012, 31, *%@, ' 592/. *%53J%B, 507' %0/. -C*%@-. 02367/3*%K>*% ! ! G
C a a a b a D a a a (%
k-, 310%8329, .027: %@2/0/6: %) , M7(% , C235. *%92.7-50*% ! ! G%
F b a D a a ab b a a
8KL %@2/R, ' 592/. 50%a./-M% , C235. *%@-. 02367/3*%K>*% ! ! ! %
XO a b a a a %
: 12, 372E21%k8 N2, 0% , C235. * 92.7-50*% ! ! #%
M a a a a D a %8329, .027: %/E%@.2720' %Q/0-CR25*%
Q/CM5.5729, %&' : 02/0/6: % , C235. * 92.7-50*% ! ! #
U a a a a b a a
D a Q535J253%A00/12572/3%E/.%+, -. /012, 31, %L, , 7236*%>./37/*%W+*% ! ! #b%

! 5%(\$#\$\$. \$'751&\$#1,'

!"#\$dUVM a a a a a
! A.370, 3*%Q(*%W36, .0/00*%L (%_ 5.D, *%<(% 234567:*8L I a
a D a a a %W37, .3572/350% : CM/02-C%
/3%WDE5172/3%53J%>507, *%N, : ^m592^*%W1, 053J*% ! ! U'
&\$) 5920*a(*%A-J, 77, *%c! a-200, C23*%e(*%F(*%\$Q, .326025*%e(*%925234567:*81

! A.370, 3%Q(*%36, .0/DD*L (*%_5.D, *%(*% 234567:*8L

!"#bH!"!#%