

BIOM9640

6]ca YX]WU`]bgrfi a YbhU]cb

HYfa " z&\$&&



7ci fgY`Cj Yfj]Yk

GHJZ 7cbHJW`8YHU]`g

7cbj Ybcfg

BUa Y	9a U]`	5j U]`UV]`]m	@W]h]cb	D\cbY
8f`8Uj]X`HgU]	X"hgU]4 i bgk "YXi "Ui	H65	F a %\$\$' ž@]` %ž6]cgW]YbVW Gci Ĥ`fĐ&*Ł	-\$*)` , &' \$

@YW]i fyfg

BUa Y	9a U]`	5j U]`UV]`]m	@W]h]cb	D\cbY

7ci fgY'8YHJ`g

I b]hg'cZ7 fYX]h*`

Gi a a UfmicZ`h`Y'7ci fgY

H\]g`W`i fgY'gYf] Yg`Ug`Ub`]b]fcXi W]cb`hc`d`l`mg]c`c[]W]`a YUgi fYa YbhcZV]cY`YWf]Wd\Ybca YbU`UbX bYi fcgh]a i `U]cb`"H\]g`W`i fgY`XYU`g`df]a Uf]mk]h` [U]b]b[`Ub`i bXYfg]UbX]b[`cZ`h`Y`d`l`mg]W]`df]b]W]d`Yg k \]W]` [c] Yfb`h`Y`a YUgi fYa YbhcZU`V]c`c[]W]`j Uf]UV`Y`cf`gmghYa žVmU`f]UbgXi W]f`k \]W]` W`bj Yf]g`h`Y j Uf]UV`Y`]b]c`Ub`Y`YWf]W]`g][bU`"6m]h`Y`YbX`cZ`h`Y`W`i fgY`m]c] `g`l`ci `X`i bXYfg]UbX]j Uf]ci g`a YUgi fYa Ybh XYj]W]g`UbX`UddfcUW]Yg]b]W] X]b[`h`Y`i bXYf]m]b[`V]c`c[]W]`dfcW]gg`h`U]h[YbYf]U]Yg`h`Y`ei Ub]h]m]c`VY a YUgi fYX`cf`W`b]fc`"YX`"H\Y`VUg]Wa YX]W]`]b]g]fi a Yb]U]cb]i gYX`W]b]W]`m]c`d`Yf]Z`fa `h`YgY`Z`b]W]cb]g]g U`gc`Yi Ua]b]YX`"H\]g`W`i fgY`U`Ug`U`Z`W`g`cb`V]cY`YWf]Wd\Ybca YbU]z`V]cY`YWf]cXYg]ž`a YX]W]`Y`YWf]cb]W]g UbX`bYi fcgh]a i `U]cb`"H\Y`W`i fgY`]b]W] XYg`U`f]Y]]g]cb`cZ87`UbX`57`W]f]W]]h`h`Ycf]m]ž`UbXg]!cb`df]UW]W]`]b h`Y`i gY`UbX`h`Yg]h]b[`cZa YX]W]`f]UbgXi W]f]g`UbX`Y`YWf]ca YX]W]`Yei]da Ybh]b`W`a a cb`i gY`]b`c]gd]h]U`g UbX`fYgYUf]W]`"UVcf]U]c]f]Yg`h`a U`Y`a YUgi fYa Ybh]g`cZV]ca YX]W]`j Uf]UV`Yg`cZ]W]b]W]`g][b]Z]W]b]W]"

7ci fgY'5]a g

H\Y`U]a g`cZ`h]g`W`i fgY`UfY`h`c`.

-]b]fcXi W]`gh] XYb]h]c`h`Y`Z`bXUa Yb]U`g`cZ`Y`YWf]W]`Yb[]b]Y]f]b[`Ug`]h]fY`U]h]g`h`c`i bXYfg]UbX]b[V]cY`YWf]Wd\Ybca YbU`UbX`bYi fU`]gh]a i `U]cb`
- i bXYfg]UbX`h`Y`d`l`mg]W]`df]b]W]d`Yg`k \]W]` [c] Yfb`h`Y`a YUgi fYa YbhcZU`V]c`c[]W]`j Uf]UV`Y`cf`gmghYa `VmU`f]UbgXi W]f`k \]W]` W`bj Yf]g`h`Y`j Uf]UV`Y`]b]c`Ub`Y`YWf]W]`g][bU`

hlyfy'k j''vy'u'' \ci f'dyf]cX'wta df]g]b['u''ywhi fy'ubx'ga u'' [fci d'yi yfw]gYg#i hcf]U'gž [fci d'X]gW gg]cbg
ubx'chlyfa yhcXg'hc'ZUW]fUHY'ghi XYbh'YUfb]b[''-# hly''UHYf'\U'ZcZHY'hyfa 'U'gyhcZ'UVcfUhcfm
YI dYf]a Ybhtg'k j''vy'wcbXi WYX'hc'fy]bZcfW' dfUW]WU''UgdYWg'cZV]ca YX]WU'']bghfi a Ybht]cb'ubX
V]cY'YWF]Wd\Ybca YbU''DfcV'Ya 'gc'j]b[']g'ub'YggYbh]U'wta dcbYbhcZh]g'gi V'YWH'5'A ccX'Y'wta fgYk UfY
a cXi 'Y'\Ug'VYYb'YghU'V]g\YX'Zcf'h]g'gi V'YWH'f'h'd.##a ccX'Y''h'hi bgk ''YXi ''Ui 'E''I dWta]b['hi hcf]U''fUg_gž
X]gW gg]cb[fci dg'ubX''YWHi fy'bchYg'ubX'fygci fW'ya UHYf]U'g'k j''vy'a UXY'Uj U]UV'Y'cb'h]g'g]h'Xi f]b['hly
hyfa ''D'YUgY''cc_UhUbbci bW'ya Ybhtg'cb'A ccX'Y'Zcf''Ugha]bi h'W'ub[Yg''5ggYgga Ybhtg'ubX'ZYXVUW'cb
hi hcf]U''k cf_k j''vy'fy[i 'Ufmdfcj]YX'hc'hly'ghi XYbhtg''

H\]g'wta fgY'fyei]fyg'mci 'hc'i bXYfg]ubX'hly''ywhi fy'a UHYf]U''ubX'hlyb'Udd'm'hly'_bck 'YX[Y'hc'VUg]W
V]c]bghfi a Ybht]cb'Udd']W]h]cbg''-#]g]ja dcf]ubh'hc'i bXYfg]ubX'hly'Z bXUa YbhU'wcbW'dhtg'Ug'gccb'Ug
dcgg]V'Y'ubX'hc'Ug'_Zcf'\Y'd']Zmci 'Xc'bhci bXYfg]ubX''5'hly'bx'U''hly''ywhi fyg'ubX']Zgca Yh]b[']g'i bWYUfz
d'YUgY'Ug'_ei Ygh]cbg''A U_Y'gi fy'mci 'fy] jYk 'U''hly''ywhi fy'bchYg'ubX'fyUX'U''a UHYf]U''h.Uh]g'gi [[YghYX
cf'\ubXYX'ci h'7'Ugg'dUfh]W]dU]h]cb'h'fci [\ 'UHY'bx'ubW'U'h'ywhi fyg'ubX'dUfh]W]dU]h]cb']b'WUgg'YI Yfw]gYg'ubX
[fci d'k cf_k j''vy'fy'U'U'ck 'Zcf'U'h'f]ub]h] Y'a YhcXg'cZUVgc'f]b['hly'fy'Yj'ubh]b'Zcf'a U]h]cb''

Hly'a UHYf]U'']g'X] YfgY'ubX'bchUg'h] [\hm'']b_YX']bhc'ub'c'j YfU''ub'nt]WU']ghfi W'h fy'Ug']b'gca Y'chlyf
gi V'YWH']mci 'k j''bYX'hc'vy'dfydUfYX'hc'Ugg]a]UHY'ZUW]g'fy'U]h]b['hc'U''Uf[Y'bi a VYf'cZ]Z]fYbh
a YUgi f]b[']bghfi a Ybhtg'ubX'a YUgi fYa Ybhdf]bW]d'Yg''-Zmci 'hfyU'h]g'Ugg]a]U]h]cb'g]a d'mUg'ub'YI Yfw]gY
]b'fch'Y'Ufb]b[ž'hly'j'c'i a Y'cZa UHYf]U''k j''a U_Y']h'UfX''-Zmci 'VYwta Y'gi Z]M]Ybh]m]bj'c'j YX'ubX
]bh'fyghYX']b'hly'a UHYf]U''Zmci 'k j''Z]bX']h'YUgm]hc'wta dfY\YbX/] Yfma i W'Ygg'fch'Y'Ufb]b['k j''vy
bYXYX'VYWHi gY'mci 'k j''i bXYfg]ubX'hly'df]bW]d'Yg'ubX'vy'UV'Y'hc'k cf_'ci h'hly'wcbgYei YbW'g''

5XX]h]cbU'7ci fgY' #Zcfa U]h]cb

Dfygi a YX'_bck 'YX[Y

Gca Y'a UH'Ya U]h]g'VUW' [fci bX']g'YggYbh]U'']mci 'g\ci 'X'\Uj Y'df]cf'YI d'cgi fy'hc'wta d'YI 'bi a VYfg
ubX'U' [YVfU'fYei]j' U'Ybh'hc'wta d'Y]h]cb'cZ'g]hm]Uf'a UH'Ya U]h]g']'A UH'g' %5'ubX' %6' - #]g'\Y'd'Z'
Vi h'bh'YggYbh]U''h'Uhmci '\Uj Y'gca Y'_bck 'YX[Y'cZY'YWF]WU'W'fW]rg'ubX'gm]gh'a g''Hly'YggYbh]U''W'fW]rg
a UHYf]U''k j''vy'fy] jYk YX'Xi f]b['hly'wta fgY''

F Y'U]h]cbg'hc'chlyf'6-€A 'wta fgYg

6-€A - * (\$'wcbg]gh]cZ]bh] [fUHYX''YWHi fyžhi hcf]U''ubX'dfUW]WU''k cf_'ubX']bWi XYg'U'a U'cf'fy]]g]cb'cZ
Y'YWF]WU''Yb[]bYYf]b['_bck 'YX[Y'Ug'k Y''Ug'U'ZcW'g'cb']bghfi a Ybht]cb'ubX'a YUgi fYa Ybhfy'U]h]b['hc
V]cY'YWF]Wd\Ybca YbU''6-€A - *) \$'f6]cgYbgc'fg'ubX'hfUbgXi W'fg'f'fi bg']b'h%'ubX'ZcW'gYg'cb'chlyf
gYbg]b['ubX'hfUbgXi W]h]cb'a YW'ub]ga g'fX]gd'UVW'a Ybht'ZcfW'ž'j'c'i a YždfYggi fyžZck žYhW'ei gYX'Zcf
W]b]WU''a YUgi fYa Ybhtg''Gca Y'cZHY'VUg]WY'YWF]WU''Yb[]bYYf]b['Z' bXUa YbhU'g']b'f'cXi W'X']b'6-€A - * (\$
k j''vy'Uggi a YX'_bck 'YX[Y']b'6-€A - *) \$''

Hly'wta fgY'6-€A - ** \$'f'ha d'ubhUV'Y'6]cb]W]g]Z'YI d'ubXg'cb'UgdYWg'cZY'YWF]WU''Yb[]bYYf]b['W'fW]hgž
V]cY'YWF'cXYgžV]cdch'bh]U'g'ubX'byi fU'gh]a i 'U]h]cb'Z'ca 'hly'dYfgdYW]j' Y'cZXYg][b]b['ubX'a Ubi ZUWHi f]b[
ub'ja d'ubhUV'Y'hlyfUdYi h]WXYj]W''Hly'wta fgY'6-€A - +%'fA cXY'']b['C'f[Ubgž'H]ggi Yg'ubX'8Y]]W'gk
dfcj]XYg'U'dfUW]WU''c'j Yf] jYk 'cZwta di h]h]cb'U'a cXY'']b[']b'V]cYb[]bYYf]b[ž'ZcW'g]b['cb'U'fub[Y'cZ
Udd']W]h]cbg']bWi X]b['Y'YWF]WU''gh]a i 'U]h]cb'cZbYi fU'ubX'W'fX]UW]h]ggi Yg''Hly'_bck 'YX[Y' [U]bYX']b
6-€A - * (\$'k j''Ugg]gh]b' i bXYfg]ubX]b['hly'gy'dfcW'ggYg''

5ggYgga Ybh

5ggYgga YbhUg_	K Y][\h	8i Y'8UHŸ	7ci fgY'@YUfb]b[Ci hŸa Yg'5ggYggYX
%"Hi ħcf]U`gž< UbX`]b E i Ygh]cbg	%)	GYd!&&žGYd!&- žC WŸ * ž C WŸ%	%ž' &ž'
&"@UVcfUħcfm5ħYbXUbWŸ	%)\$	K YY_g'+!%\$	&
' " :]bU`9I Ua	(\$	H65`fXi f]b[`YI Ua `dYf]cXŁ	&ž' ž(
("A U`cf@UVcfUħcfmF Ydcfh	%)	H65`fUZYf'k _`%\$Ł	&ž(ž)
)"E i]nnYg	&\$	GYd!&- žC WŸ%	%ž' &ž'

5ggYgga Ybh%`Hi ħcf]U`gž< UbX`]b`E i Ygh]cbg

8i Y`XUHŸ. `GYd!&&žGYd!&- žC WŸ * žC WŸ%

5`a U`cf`UgdYWħcZħ]g`Wci fgY`]g`dfcV`Ya`gc`j`]b[``H\]g`YbhU]g`WŁccg]b[`ħY`Uddfcdf]UHŸ`a`cXY`ž
]a`d`Ya`Ybh]b[`]h`W`ffY`Wħm]UbX`Uff]j`]b[`Uh`ħY`W`ffY`Wħ]Ub`gk`Yf`Hc`W`a`d`Yħ`ħY`ħi`ħcf]U`gž`gh`XY`bh`k`]]`i`gY
ž`bXUa`YbhU`a`UHf]U`ž`ca`ħY`Y`Wħ`fYg`"Hi`ħcf]U`g`g\ci`X`VY`gi`Va`]ħY`X`cb`ħ]a`Y`ħfci`[`\`A`ccX`Y`"A`Uf_g
a`UmVY`XYXi`WħX`ž`cf`UHŸ`gi`Va`]gg]cb`k`]ħci`hdf]cf`Uddfcj`U`"

F`Y`UHŸX`[`fUXi`UHŸ`WdUV`]ħYg`]bWħ`XY.

- I`bXY`gh]UbX]b[`cZħY`X]gWd`]bY`]b`]hg`]bhYfX]gWd`]bUfmW`bħYI`h
- F`][`cfci`g`]b`UbU`m]g]Y`Wħ]g`WħX`fZYWħ]cbY`_`k`Wke` `‰` _` `YX\$`g]b[`ħU]`g`WŁg

F Y`UhrX`[fUXi UHr`WUdUV`])hYg`]bWl XY.

- I bXYfghUbX]b[`cZkY`X]gWd`]bY`]b`]hg`]bhYfX]gWd`]bUfmVc`bhYI h
- F][cfcI g`]b`UbU`mg]gž`W]hei Y`UbX`fYZYW]cb
- 5V`Y`hc`Udd`mi`bck`YX[Y`UbX`g_]`g`hc`gc`j`]b[`dfcV`Ya g
- 7 UdUV`Y`cZ]bXYdYbXYbž`gY`Z`X]fY`W`X`d`f`U`W`j`W`

5ggYgga Ybh(. :A U`c`f`@UVcfUhc`fmF Ydcfh

8i Y`XUhr. :H65`fUž`f`k`_`%\$Ł

C.bY`UVcfUhc`fmk`j`VY`W`cgYbž`UbX`h`Y`gh`XYbhk`j`VY`YI`dY`W`X`hc`d`f`Y`d`U`f`Y`U`Z`c`fa`U`UVcfUhc`fmfYdcfh`h`Uh

!% 'Bcj Ya VYf

F Ygci fWg

DfYgW]VYX F Ygci fWg

Gi Va]gg]cb'cZ5ggYgga YbhiHUg_g

@UVcfUhcfmfYdcfng'UbX'a U'cf'Ugg][ba Ybht'k]''fYei]fY'U' [Bcb'D'U\[\]Uf\]ga '8YWUfU\]cb'7cj Yf'G\YYH'](#)

5gg][ba Ybht'g\ci 'X'VY'gi Va]H'X'cb'h]a Y''5'XU]mdYbU'micZ) i 'cZhY'a Uf_g'Uj U]'UV'Y'Zcf'hUh
Ugg][ba Ybhk]''Udd'mZcf'k cf_'fYW'j YX'UZ'Yf'hY'Xi Y'XUH''5bmiUgg][ba Ybhia cfY'h'Ub') 'XUmj''UH'k]''bch
VY'UW'Wdh'X''H\Y'cb'mYI Ya dh]cb'k]''VY'k \Yb'df]cf'dYfa]gg]cb'Zcf''UH'gi Va]gg]cb'\Ug'VYYb'[fUbh'X'Vm
hY'7ci fgY'W'cfX]bUhc'f''9I hYbg]cbg'k]''VY'[fUbh'X'cb'mcb'a YX]W'cf'W'ca dUgg]cbUH' '[fci bXg'i bXYf
YI hfYa Y'W'fW'a g'U'bv'W'g''

5 WUXYa]W< cbYgmiUbX`D`U[]Uf]ga

D@5; ≠F ≠GA

6Yk UfY`5b`Ugg][ba Ybh\Uh]bWl XYg`d`U[]Uf]gYX`a UHf]U`k]`fYW]j Y`U`\$i : U]žUbX`gh XYb]k`k \c

5WUXYa]W=Zcfa Uh]cb

7CI FG9'9J5@! 5H€B'5B8'89J9@CDA 9BH

Gh XYbhZYXVUW_ \Ug\YdYX'hc'g\UdY'UbX'XYj Y'cd'h\]g'Wci fgYž]bWi X]b['ZYXVUW_cVHU]bYX'Zca'cb!
]bY'Yj U'i Uh]cbg'Ug'dUfhcZI BGK 'g'Ug'dUfhcZI BGK 'g'a m9I dYf]YbW' dfcW'gg"Mc'i 'UfY'\[\m
YbWci fU[YX'hc'Wca d'YH'gi W\ 'Ub'cb!]bY'Yj U'i Uh]cb'hck UfX'hY'YbX'cZHYfa "': YYXVUW_UbX'gi [[Ygh]cbg
dfcj]XYX'k]"VY'ja dcfhUbh]b]ja dfcj]b['hY'Wci fgY'Zf'Z hi fY'gh XYbthg"

85H9G'HC'BC H9

FYZf'hc'A m BGK 'Zcf'æ dcfhUbh8UH'gžUj U]UV'Y'Uh
[\hfdg.##a m'i bgk "YXi "Ui #gh XYbh#fYgci fW'g#? Ym8UH'g"\ha`](#)

57589A ⇒ '58J ⇒9

: cf]bZcfa Uh]cb'UVci h

- ""B cH'g'cb'UggYgga Ybthg'UbX'd'U[]Uf]ga ž
- ""GdYWU"7 cbg]XYfU]cbgž
- ""GW'cc" Gh XYbh9h]Vg'C Z]W'fz'UbX
- ""69GG

fYZf'hc'hY'GW'cc" k YVg]H'Uj U]UV'Y'Uh
[\hfd.##k k "Yb\[\]bYYf\]b\["i bgk "YXi "Ui #/\]ca YX\]WU'!Yb\[\]bYYf\]b\#

Gi dd`Ya YbHfM9I Ua]bUh]cbg.

Gi dd`Ya YbHfM9I Ua]bUh]cbg'Zcf'HYfa '%&\$&&'k]"VY'\Y'X'cb'fH67 E'g\ci 'X'mci 'VY'fYei]fYX'hc'g]hcbY"

H\]g'Wci fgY'ci h]bY'gYthg'ci hXYgW]dh]cb'cZUggYg'Uh'hY'XUH'hY'7 ci fgY'Ci h]bY']g'di V']g\YX" H\Y
bUh fY'cZUggYg'a UmVXUb[Y Xi f]b['hY'HYfa 'UZf'hY'7 ci fgY'Ci h]bY']g'di V']g\YX" 'A ccX'Y'g\ci 'X'VY
Wcbgi 'hY'Zcf'hY'i d'hc'XUH' WUgg'XYgW]dh]cbg" 'Z'hYfY']g'Ubm]bWcbg]gh'bWni]b'hY'XYgW]dh]cb'cZ
UW]j]h]Yg'VYtk YYb'hY'I b]j Yfg]m]h]a YHUV'Y'UbX'hY'7 ci fgY'Ci h]bY'fUg'i dXUH'X']b'A ccX'Y'Udd']Yg"

⇒a U[Y'7 fYX]h

fW'G\i H'Yfg'hcW_ ⇒a U[Yg

7F ⇒CG

7F ⇒CG'Dfcj]XYf'7cXY.'\$\$\$- ;

5W_bck `YX[Ya YbhcZ'7ci bhfm

K Y'UW_bck `YX[Y'hY'6YXY[U'dYcd'Y'k \c'UfY'hY'fUx]h]cbU'W'g'hcX]Ubg'cZ'hY'UbXg'cb'k \]W'I BGK

? Ybg]b[hcb`Wla di g`lg`cWJHYX"