

GWX`UZdfcV`Ya Y`]a 'K c\ba cV]`. '8]Y 7Ua d]b[!7ca a i b]hm'gWX`À[h'5`Ufa °

9bhXYW_Yb^G]Y^X]Y^< YfUi gZcfXYfi b[Yb^i bX^@Ogi b[Yb^]a K c\ba cV]`!7Ua d]b[^]b^BcfXXYi hgW\`UbX.^?ca Zcfhž ?cbghfi _h]cbgZY\`Yf^i bX^_fYUh]j Y^5bgAhnY"



BcfXXYi hgW `UbXž'8Yi hgW `UbX'!'7Ua d]b['k]fX']a a Yf
VY`]YVhYfž'VYgcbXYfg']b'BcfXXYi hgW `UbXž'k c'X]Y': fY]\Y]hii bX'XYf
?ca Zcfh'j cb'K c\ba cV]`Yb'X]Y'A YbgW Yb'Ub`cW_Yb'''8cW k]Y'X]Y
GY]hY'a c]b''XY'VYf]W hYhž'g]bX'X]YgY'a]hh`Yfk Y]`Y'ni a 'HY]`'a]h
?cbghfi _h]cbgZY\`Yfb'i bX'i bdfU_h]gW Yb'@Ògi b[Yb'_cbZfcbh]Yfh''

\$\D\$VYgcbXYfY']a 'GW `UZVYfY]W []Vh'Yg'\Ài Z]['DfcV`Ya Yž'X]Y'VY]
j]Y`Yb'7Ua dYfb'Ui Z'I ba i h'ghc» Yb''

9]b 'U_hi Y``Yg'H\Ya U']b 'XYf'7Ua d]b[!7ca a i b]hm'XfY\hig]W\'i a J YfXi b_Y`i b[gdfcV`Ya Y']a '?cdZVYfY]W\'j cb'DÒgg`!

K c\ba cV]`Yb"'8cfh'g]bX'Bi hnYf'a]h'XYf'ghUbXUfXa À»][Yb DUd]YfZU`hj YfXi b_Y`i b['i bni Zf]YXYbž'X]Y'g]W\'U`g'UbZÀ``]['ZØf 6YgW\ÀX][i b[Yb'Yfk Y]gh"' \D'XYb'8]g_i gg]cbYb'k]fX'cZha U`g'Ui Z

5`hYfbUh]j Yb`k]Y`D`YI][`Ug`cXYf`GdYff\c`nd`UhhYb`j Yfk]YgYbži a X]Y`J YfXi b_Y`i b[`ni 'j YfVYggYfb"'Ÿ\b`]W\Y`< YfUi gZcfXYfi b[Yb k i fXYb`Ui W\`VY]`UbXYfYb`A Uf_Ybž'k]Y`6ØfghbYfž'ZYgh[YghY``h" 8 YbbcW\`[]Vh`Yg`Ui W\`7 Ua dYfž'X]Y`_fYUh]j Yg`; YgW\]W_`nY][Yb i bX`VY]gd]Y`gk Y]gY`]b`E i Yff]W\hi b[`gW\`UZYbži a `X]Y JYfXi b_Y`i b[qdfcV`Ya Uh]_`ni i a [Y\Yb"

FYdUfUhi fVYXUfZi bX?cbghfi _h]cbgZY\`Yf

9]b'k Y]hYfYg'6Y]gd]Y``ZØf'?cbghfi _h]cbga Àb[Y``]gh'XUg
JYfXi b_`i b[ggmghYa ']a 'K YghZU`]U'7c`i a Vi g') (\$'58 ž'XUg'bUW\
bi f'ZØbZ'\J\fYb'; YVfUi W\'Y]bYb'8YZY_h'Ui Zk Y]gh''<]Yf'j Yfa i hYh
a Ubž'XUgg'8ca Yh]WU`g'<YfghY``Yf'Y]bYb'?cbghfi _h]cbgZY\`Yf
VY][YhfU[Yb'\Uh''8]Y'DfcV`Ya Y'g]bX'_`Uf.'8Yf
JYfXi b_`i b[ga YW\Ub]ga i g'Ua 'GY]hYbZYbghYf'`Àggh'g]W\'b]W\h
a Y\f'j c``gh\AbX]['\cW\n]Y\Ybž'k Ug'X]Y'Bi hnYf'j cf'DfcV`Ya Y'ghY``hž
k \A\fYbX'XUg': `]Y[Yb[]hhYf'XYbbcW\'Y]bk UbXZfY]'Z b_h]cb]Yfh''

I a 'XYb'A Ub[Y`gY`Vgh'ni 'VY\YVYbž'g]bX'Y]b][Y'K Yf_nYi [Y'bÒh][ž XUfi bhYf'?fYi n!'i bX'Hcfl!GW\fUi VYbXfY\Yf'gck]Y'Y]b'gW\UfZYg A YggYf"'8]Y'FYdUfUhi f'YfZcfXYfh'X]Y'8Ya cbhU[Y'j cb'('?UddYb i bX'XUg'@ÒgYb'j cb']bg[YgUa h', 'GW\fUi VYbž'i a 'XYb'FU\a Yb j ca ': YbghYf'UVni bY\a Yb"'8UXi fW\k]fX'XYi h']W\ž'k]Y'\cW\'X]Y 6Y`Ughi b['Ui Z'X]Y': Ø\fi b[gZÀXYb']ghž'XU'X]Y'-\$!; fUX!I a 'Yb_i b[i bX'FY]Vi b['cZh'ni f'6YgW\ÀX][i b['ZØ\fYb"

A Uf_hg]hi Uh]cb i bX HfYbXg

8]Y'K c\ba cV]`]bXi ghf]Y'\Uh'g]W\']b'XYb'`YhnhYb'\J\fYb'ghUf_
Ybhk]W_Y'h''@Ui h'; A = \partial g][\hg'k]fX'X]Y'[\cvU\Y'A Uf_h[f\omega\partial y\f'\&\s&\('\ui\ Z''\, \zeta\ A\]``]UfXYb'I G8'[YgW\Ahnh\zeta\ a\]h
Y]bYa 'dfc[bcgh]n]YfhYb'K UW\ghi a 'jcb'('i 'dfc'\J\f'\V]g'\&\'("\s\)8]YgY'_Ubb'Xi fW\'hYW\bc\c[]gW\Y': cfhgW\f]hhY'i bX'j Yf\AbXYfhY
JYfVfUi W\Yfdf\AZYfYbnYb'ni g\Ahn`]W\'Ub[Y_i fVY\h'k YfXYb''\
<YfghY\`Yf'Yfk Y]hYfb']\f'5b[YVch'Xi fW\']bbcj Uh]j Y': YUhi fYg'i bX
Ui W\'X]Y'JYfZØ[VUf_Y]h'i bhYfgW\]YX\`]W\Yf'A chcfj Uf]UbhYbz
XUfi bhYf'9\Y_hfc!'gck]Y'6\Ybn]bZU\fnYi [Yz'j YfVYggYfb'X]Y
A Uf_hXi fW\Xf]b[i b["

Ni [`Y]WX 'nY][Yb 'X]Y 'NU\ `Yb Z XUgg 'XYf 'Yi fcd À]gWX Y 'A Uf_hz XYf &\$&('j cfUi gg]WX h`]WX ')) 'I 'XYg'; YgUa ha Uf_hYg'Ui ga UWX Yb 'k]fX Z ghUf_'j cb 'Y]bYf'U_h]j Yb 'F J!DfcXi _h]cbg]bXi ghf]Y i bX 'UhhfU_h]j Yb 7 Ua d]b[Ub`U[Yb 'dfc Z]h]Yfh" '8]YgYf 'HfYbX'k]fX 'Xi fWX 'ghUf_UbghY][YbXY 'Hci f]ghYbnU\ `Yb ']b 'XYf 'F Y[]cb '5g]Yb!DUn]Z]_i bhYfghØhnhz k c']a a Yf'a Y\f'FY]gYa cV]`Y'Ui Z'XYb 'GhfU» Yb i bhYfk Y[g'g]bX" '8 YbbcWX 'ghY\Yb'? Ài ZYf'j cf' < YfUi gZcfXYfi b[Ybz k]Y'\c\Yb'=bj Ygh]h]cbg! i bX 'K Ufhi b[g_cghYbz'k Ug']bbcj Uh]j Y :]bUbn]Yfi b[gcdh]cbYb'i bX '[Yn]Y`hY'=bj Ygh]h]cbYb']b': cfgWXi b[i bX '9bhk]W_`i b['YfZcfXYf`]WX 'a UWXh''

8 Y hU]`g	
Cfh	BcfXXYihgWX`UbXž8YihgWX`UbX
Ei Y``Yb	• k k k "a c]b"XY
	• k k k "k YghZU`]U!ZUb"XY
	• k k k "[a]bg][\ hg"Wca

6 Ygi WX Yb 'G]Y 'i bg 'Ui Z 'X]Y!bUWX f]WX hYb "Wca