### 9d]WDmh\cb`<ibh`?]W<u>g</u>CZZ.`7Ub`6fYjUfX 6Uhh`Y`=bjUg]jY`6YUghg3

8]gWcjYf`6fYjUfX`7cibhm⁄, \$'-/g`fc`Y`]b`h\Y`UbbiU``:`cf]XU Dmh\cb`7\U``Yb[Yž`UXXfYgg]b[`h\Y`YWc`c[]WU``h\fYUh`cZ ]bjUg]jY`6ifaYgY`dmh\cbg"



6fYj UfX '7ci b hmž: `cf]XUž'I G5 '! 'H\]g'k YY\_'a Uf\_g'Ub YI W]h]b[ h]a Y 'Zcf: `cf]XU'Ug'h\Y'Ubbi U`: `cf]XU'Dmh\cb '7\U`Yb[Y'\_]W\_g'cZZž ]bj ]h]b[ 'fYg]XYbhg'UbX'j ]g]hcfg'hc'dUfh]W]dUhY']b'h\Y'VUhh`Y'U[U]bgh ]bj Ug]j Y '6i fa YgY'dmh\cbg" 'H\Y'Wca dYh]h]cb'cZZ]W]U``m'VY[Ub'Uh %&.\$%'U"a "'cb'\$`m'%'UbX'fi bg'i bh]`') 'd"a "'cb'\$`m'&\$"'5g'h\Y \i bh'i bZc'Xgž']hg'YggYbh]U``hc'fYWc[b]nY'h\Y'YWc'c[]WU``h\fYUhg dcgYX'Vm'h\YgY'g`]ddYfm']bj UXYfgž'dUfh]W' 'Uf`m']b'6fYj UfX'7ci bhmž k \YfY'g][\h]b[g'\Uj Y'VYWca Y'a cfY'ZfYei Ybh']b'fYWYbh'mYUfg" :`cf]XU g'dmh\cb'dfcV'Ya ']gb h'bYk /']h'U``'VY[Ub'k]h\`h\Y'Z]fgh g][\h]b[']b'h\Y'9j Yf[`UXYg'VUV\_']b'%- +- ž'UbX'g]bWY'h\Ybž 6i fa YgY'dmh\cbg'\Uj Y'ghYUX]`m'g`]h\YfYX'h\Y]f'k Um'UWfcgg'h\Y ghUhY"

Hc 'd Ufh]W]d UhY ']b 'h\Y '\i bhž']bX]j ]Xi U`g`a i gh'd Um'U'` &) fY[]ghfUh]cb 'ZYY 'UbX 'Wca d`YhY 'cb`]bY 'hfU]b]b[ 'h\fci [ \ : @Dmh\cb7\U``Yb[Y"cf[ "'H\]g 'mYUfž'h\YfY g'U'hchU`'df]nY 'dcc``cZ ` &) ž\$\$\$ž'k ]h\ 'U`\YZhm`` %\$ž\$\$\$ 'cZZYfYX 'Ug'h\Y'I `h]a UhY'; fUbX Df]nY 'Zcf'h\Y'dUfh]W]dUbh'k \c'WUdhi fYg'h\Y'a cgh'dmh\cbg"'K ]h\ cj Yf'&&ž\$\$\$'dmh\cbg'fYa cj YX'g]bWY 'h\Y'Wca dYh]h]cb g']bW/dh]cb ]b '&\$\$\$z'h\Y'Yj Ybh'\Ug'VYWca Y'Wfi W]U``]b 'a UbU[ ]b[ 'h\]g']bj Ug]j Y gdYW]Ygž'Ug'i g[ g"[ cj '\][ \`][ \hg'h\Y'bYYX'Zcf']bbcj Uh]j Y XYhYWh]cb 'UbX'Wcbhfc``ghfUhY[]Yg"': cf']bghUbWYz'hYW b]ei Yg'bck ]bWi XY'Ybj ]fcba YbhU``8B5'fY8B5Ł'Zcf'`cWUh]b[ 'dmh\cbg'UbX

## FY[i`Uh]cbg'UbX'GhfUhY[]Yg

H\Y': `cf]XU'Dmh\cb'7\U``Yb[Y']g'bch'a YfY`m'U'\i bh]b['Yj Ybh/']h U]a g'hc'fU]gY'Uk UfYbYgg'UVci h']bj Ug]j Y'gdYW]Yg'UbX'h\Y]f YWc`c[]WU``]a dUWh"'9UW\'dmh\cb'fYa cj YX'fYdfYgYbhg'U'ga U`` j]Whcfm']b'h\Y'Z][\h'hc'dfchYWh': `cf]XU g'f]W\'V]cX]j Yfg]hm" <i bXfYXg'cZ'dUfh]W]dUbhg'hmd]WU``m'fY[]ghYf'YUW\'mYUfž'UbX Uddfcl]a UhY`m'&\$\$'dmh\cbg'UfY'fYa cj YX'Ubbi U``m'Zfca 'h\Y 9j Yf[`UXYgž'k]h\'g][b]Z]WUbh'\Y`d'Zfca 'di V`]WYb[U[Ya Ybh"

K \UhgʻUhʻghU\_Yʻ\YfY3ʻK Y``žʻUgʻXYhU]`YXʻVmʻ**Z**k g"[cj žʻ6i fa YgY dmh\cbgʻ\Uj YʻUʻj cfUW]ci gʻUddYh]hYžʻWcbgi a ]b[ʻUʻk ]XYʻUffUmʻcZ bUh]j Yʻk ]`X`]ZY"ʻH\Ymʻ\Uj YʻVYYb``]b\_YXʻhcʻg][b]Z]WUbhʻXYW]bYgʻ]b gca YʻgdYW]Ygžʻ]bWi X]b[ʻUʻXYj UghUh]b[ʻ-)ı 'XYWfYUgYʻ]bʻa Ua a U` dcdi `Uh]cbgʻ]bʻ9j Yf[`UXYgʻBUh]cbU``DUf\_ʻZfca ʻ%--\*'hcʻ&\$%\*"ʻK ]h\ `]hh`YʻhcʻbcʻbUhi fU``dfYXUhcfgʻ]bʻh\YʻUfYUžʻh\Y]fʻdcdi `Uh]cb VU``ccbgʻi bWcbhfc``UV`mž'dcg]b[ʻgYj YfYʻf]g\_gʻhc``cWU``YWcgmghYa g"

### 9Wc`c[]WU`'=a dUWh

5WWcfX]b[`hc`: `cf]XU`HcXUmž`XcW a YbhYX`g][\h]b[g`]b`6fYjUfX fYjYU``^igh`\ck`WcgY`h\YgY`dmh\cbg`\UjY`[chhYbž`]bWiX]b[`U dmh\cb`fYacjYX`Zfca``h\Y`HA`; ccXk]b`KUhYfZck``AUbU[YaYbh 5fYU`cb`CWhcVYf`&-ž`&\$&' ž`UbX`Ubch\Yf`ZcibX`XYUX`cb`AYff]hh =g`UbX`BUh]cbU``K]`X`]ZY`FYZi[Y`]b`CWhcVYf`&\$&&"`H\]g`WfYYd]b[ dfYgYbWY`ibXYfgWcfYg`h\Y`if[YbWm`k]h\`k\]W\`fYg]XYbhg`UbX Uih\cf]h]Yg`aigh`UXXfYqg`h\Y`q]hiUh]cb" ig]b[`XYhYWh]cb`Xc[gž`k\]W\`\UjY`g\ckb`\][\Yf`giVWW/gg`fUhYg h\Ub`\iaUb`hYUag"

=b``][\hcZh\Y`]bWfYUg]b[ bi a VYfcZdmh\cbgžh\Y`I "G": ]g\`UbX K ]`X`]ZY`GYfj ]WY`\Ug`hU\_Yb`g][ b]Z]WUbh`ghYdg`U[ U]bgh`h\Y]f`gdfYUX" =b`5df]``&\$&%ž6i fa YgY`dmh\cbg`k YfY`XYg][ bUhYX`Ug`Dfc\]V]hYX`]b :`cf]XUž``]a ]h]b[`dcggYgg]cb`UbX`U]a ]b[`hc`W`fV`h\Y]f`bi a VYfg Zi fh\Yf"

### 5 '7 U``'hc '5 Wh]c b

$$\label{eq:strain} \begin{split} & 5g^ifYg]XYbhg^i[YUf^iid^2cf^h\Y^cb[c]b[^Dmh\cb^7\U^Yb[Yž']hg^U\\ [ccX^h]a Y^hc^fYZYWhcb^h\Y^VfcUXYf^]a d^]WUh]cbg^icZ^h\]g^i]ggi Y"\\ & Dmh\cbg^bch^cb^mX]gfidh^YWc^c[]WU^VU^UbWY^Vih^U^gc^WUffm\\ & X]gYUgYg^h\Uh^WUb^UZZYWhbUh]jY^k]^X^]ZYž^ZIfh\Yf^Wcad^]WUh]b[^h\Y\\U^fYUXm^XY^]WUhY^Ybj]fcba Ybh^cZ^gcih\Yfb^{:cf}XU"^CVgYfjUh]cbg\\ & UbX^YbWcibhYfg^k]h\h\YYgY^]bjUg]jY^gbU_Yg^WUb^VY^fYdcfhYX^hc\\ & h\Y^{:}cf]XU^{::}g\UbX^K]^X^2ZY^7cbgYfjUh]cb^7caa]gg]cbg^9Ich]W\\ & GdYW]Yg^{:}ch^{:}bY^{:}Dmh\cbg^{:}bYYX^hc^VY\\ & \lambdaiaUbY^m_]^YX^cb^{:}g]hY^{::}jY^hfUbgdcfh^{:}g^{:}bch^{:}CYX''\\ \end{split}$$

: `cf]XU g`Z][ \h`U[ U]bgh`h\Y`]bj Ug]j Y`6i fa YgY`dmh\cb`fYa U]bg`U Wca a i b]hm`YZZcfhž`U`fYa ]bXYf`cZ`\ck `]bhYfWcbbYWhYX`k Y`U```UfY k ]h\`ci f`Ybj ]fcba Ybh"`K ]h\`W\U``Yb[ Yg`U\YUXž`h\YfY g`gca Yh\]b[ hc`VY`gU]X`Zcf`h\Y`fYg]`]YbWY`cZ`fYg]XYbhg`UbX`Ybj ]fcba YbhU`]ghg k cf\_]b[ `hc[ Yh\Yf`hc`dfchYWh`h\Y`bUhi fU``hfYUgi fYg`cZ`h\]g VYUi h]Z```ghUhY"`Gc`^c]b`h\Y`\i bhž`fU]gY`Uk UfYbYggž`UbX`\Y`d : `cf]XU`fYWU]a `]hg`bUh]j Y`\UV]hUh\_cbY`dmh\cb`Uh`U`h]a Y°

8 Y hU]`g	
Cfh	6fYjUfX 7cibhmž: `cf]XUžIG5
EiY``Yb	• k k k "Z`cf]XUhcXUm"Wca
	• k k k "Zk g"[cj
	• k k k "i g[ g"[ cj

# 6Ygi WXYb'G]Y'i bg'Ui Z.'a Y]b!k ]Yb"bYh