HU``U\UggYYžI G5'!H\Y'gi a a YfgYUgcb'Vf]b[g'U'k Uj Y'cZ WkU``Yb[Yg'Zcf'HU``U\UggYY'YUhYf]Yg'Ug'h\Y'XYdUfhi fY'cZ `Y[]g`Uh]j Y'UbX'ghi XYbh'Wfck Xg'fYgi `hg']b'U'bch]WfUV`Y'Vi g]bYgg X]d"'FYghUi fUbhg'gi Wk'Ug'sc9``Yb g'\Uj Y'fYdcfhYX'U'g][b]Z]WUbh XYWfYUgY']b'dUhfcbg'UbX'h]dg'g]bWf'gWkcc```Yh'ci hž'k]h\'gYfj Yf scfXmb'Dck Y```g\Uf]b['\ck'h\Y'g`ck'gYUgcb'X]fYWhmUZZYWhg]bWca Y'''=b'Ub']bbcj Uh]j Y'hk]ghž'Dck Y```\Ug'hi fbYX'hc'H]_Hc_'hc g\ck WUgY'h\Y'fYghUi fUbh g'VY`cj YX'a Ybi ']hYa gž'\cd]b['hc'Ybh]Wf Vch\``cWU`g'UbX'j]g]hcfg'hc'fYhi fb'''<Yf'H]_Hc_'j]XYc'\Ug'U`fYUXm [U]bYX'hfUWh]cbž'VcUgh]b['cj Yf'&ž) \$\$``]_Ygž'+\$\$'g\UfYgž'UbX'&\$\$ Wca a Ybhgž'k]h\`a Ubm'XYWUf]b['h\Y]f']bhYbh]cb'hc'j]g]h'sc9``Yb g UZhYf'gYY]b['\Yf'dcgh''H\]g'hfYbX'fYZYWhg'U'VfcUXYf'g\]Zh']b a Uf_Yh]b['ghfUhY[]Yg'Ug'YUhYf]Yg'Ya VfUWf'gcW]U`a YX]U'hc'Vccgh



9Id`cfY`\ck`HU``U\UggYY`YUhYf]Yg`UXUdh`hc`giaaYf``i``gž `YjYfU[]b[`H]_Hc_`hc`Vccgh`j]g]V]`]hm`UbX`WighcaYf Yb[U[YaYbh"

HU``U\UggYY'9UhYf]Yg':][\h'Gi a a Yf G`i a d'k]h\'H]_Hc_'A U[]W

5g bchYX]b HU``U UggYY Wca ž £9``Yb g Wc!ck bYf HYfYgU B]l UW_bck `YX[Yg'h\Y'bYYX'Zcf'ghfUhY[]WUX'i gha Ybhg'hc'cZZgYh'h\Y Xck bhi fb"'H\Y'fYghUi fUbh'd`Ubg'hc'Vccgh']hg'WUhYf]b['gYfj]WYg k \]`Y`B]L`UbX`\Yf`hYUa_'YLd`cfY`k Umg`hc`ghfYUa_`]bY`a Ybi cZZYf]b[g'UbX']adfcjY'gYfj]WY'YZZ]W]YbWm"'H\Y'fYgi`hg'cZ'U'fYWYbh gi fj Ym Zfca 'A; < 'A Uf_Yh]b[']bX]WUhY 'h\Uh'), i 'cZ'H]_Hc_'i gYfg $U_{i} Y_{i}]g_{h} X U_{f} g_{h} U_{i} f_{b} U_{h} T_{g} Y_{b} []h^{1} [^{1}]h^{1} [^{1}]h^{2}$ d`UhZcfa ž'U'bchUV`Y']bWfYUqY'Zfca '', i ']b'&\$&&"

Gi a a Yf GhfUhY []Yg Zcf @cWU 9UhYf]Yg

G]a i `hUbYci g`mžch\Yf`fYghUi fUbhqž``]_Y`<Umk UfX`<ci gYžUfY hUdd]b[']bhc 'h\Y'dchYbh]U``cZigi a a Yf'Yj Ybhg hc 'XfUk ']b a cfY

'Unn'a i g]Whc'_YYd'h\Y]f``cmU``W ghca Yf'VUgY'Yb[U[YX'k \]`Y

5g[·]h\Y[·]X]b]b[[·]gW/bY[·]Wcbh]bi Yg[·]hc[·]bUj][UhY[·]h\YgY[·]gi a a Yf

9UhYf]Ygigi Willgi5ggYa Vimicbi5XUa gži7Ni W_gi:]g\žiHNYi9[[

bYWYqqUfm'Zcf'qi qhU]b]b['Vi q]bYqq"

h\Y]f`ib]eiY`Ub[`Y`hc`WUdh]iUhY`X]bYfq"

H\Y Dck Yf cZH]_Hc_

UddYU`]b[hc bYk X]bYfg"8Ygd]hY h\Y]fYZZcfhgžh\Y g`ck gYUgcb

fYa U]bg'U'hci [\`\i fX`Y'hc'cj YfWca Yž'UbX'UXX]h]cbU``dUhfcbg'UfY

g`ck Xck bgž``cWU``YghUV`]g\a Ybhg`\Uj Y`X]j Yfg]Z]YX`h\Y]f`cZZYf]b[g"

7 UZY 'UbX '9UhY fmž UbX '< Uffm q 'GY UZccX '6Uf'/ '; f]``Y 'UfY 'U```dUfh cZ HU``U\UggYY q`j]VfUbhifYghUi fUbh'Wca a i b]hmž'YUWX hfm]b[hc Z|bX

[iYqhq"'5q\`Ym'7\UbYm'a Ybh]cbg`\cqh]b['dU]bh]b['b][\hq`UbX``]j Y

K \]`Y`hfUX]h]cbU``UXj Yfh]q]b[`cdh]cbg`\Uj Y`h\Y]f`d`UWYž`h\Y`f]qY`cZ H]_Hc_`]g`fYg\Ud]b[`\ck fYghUi fUbhg`fYUW\`dchYbh]U``W ghca Yfg" 5WWcfX]b[hc + q]Zhg"Wc a žH]_Hc c ZZYfg Ub cf[Ub]Wk Um Zcf ga U```Vi q]bYqqYq`hc`YI dUbX`h\Y]f`Ui X]YbWY`k]h\ci h`fYei]f]b[`U jUgh'Zc``ck]b["'BchUV`mž'H]_Hc_'fYWYbh`m`gifdUggYX'; cc[`Y'Ug'h\Y a cgh'dcdi `Uf'k YVg]hYž'VcUgh]b['cj Yf'%'V]``]cb'i gYfg'k cf`Xk]XY"

 $K h^{-1}hg^{-1}b[U_{b}^{-1}b_{b}^{-1}] + C_{-1}g^{-1}d^{-1}hg^{-1}V^{-1}hg^{-1}hg^{-1}V^{-1}hg^{-1}V^{-1}hg^{-1}V^{-1}hg^{-1}V^{-1}hg^{-1}V^{-1}hg^{-1}V^{-1}hg^{-1}V^{-1}hg^{-1}V^{-1}hg^{-1}V^{-1}hg^{-1}V^{-1}hg^{-1}V^{-1}hg^{-1}V^{-1}hg^{-1}V^{-1}hg^{-1}V^{-1}hg^{-1}hg^{-1}hg^{-1}hg^{-1}V^{-1}hg^{-1}$

8 Y hU]`g	
Cfh	HU``U\UggYYž'I G5
EiY``Yb	• k k k "hU``U\UggYY"Wca
	• k k k "+g∖]Zhg"Wca
	• k k k "hci WXV]ghfc"Wca

H\]gʻgi a a YfžʻHU``U\UggYYʻfYghUi fUbhgʻUfYʻdfcj]b[ʻfYg]`]YbhʻVm UXUdh]b[ʻhcʻh\YʻYVVʻUbXʻZckʻcZgYUgcbU``hfUZZ]Wʻ6m`Yj YfU[]b[d`UhZcfa g``]_YʻH]_Hc_ž'h\YmʿUfYʻbchʻcb`mʻYa VfUW]b[ʻ]bbcj Uh]j Y a Uf_Yh]b[ʻghfUhY[]YgʻVi hʻU`gcʻ]bj]h]b[ʻh\YʻWca a i b]hmʻhcʻX]gWcj Yf h\YʻWkUfa]b[ʻUha cgd\YfYʻUbX'XY`YWhUV`YʻX]g\Ygʻh\Uhʻa U_Y X]b]b[ʻci hʻUʻXY`][\hZi ``YI dYf]YbWY"ʻK]h\ʻcj Yfʻ%", ʻV]``]cbʻUWh]j Y i gYfgʻYI dYWhYXʻcbʻH]_Hc_ʻgccbž'h\Yʻdcgg]V]`]h]YgʻZcfʻWfYUh]j Y ci hfYUWk'\Uj YʻbYj YfʻVYYbʻa cfYʻdfca]g]b["

UXjYfh]g]b['Wcghg"

Hcc`gʻUbX`hUWh]WgʻZcf`gi WWYggZi ``H]_Hc_'a Uf_Yh]b[`]bWi XY i h]`]n]b[`hfYbX]b[`gci bXgž'dfcXi W]b[`cf][]bU``WcbhYbhž'UbX UWh]j Y`m`Yb[U[]b[`k]h\`j]Yk Yfgʻh\fci [\`Wca a Ybhg"': cf fYghUi fUbhgʻghfi [[`]b[`hc`h\f]j Y`Xi f]b[`ei]YhYf`gYUgcbgž]bWcfdcfUh]b[`H]_Hc_'ghfUhY[]YgʻWUbʻgYh`h\Ya`cb`h\Y`dUh\`hck UfX fYbYk YX`W ghca Yf`]bhYfYgh"`5gʻYa d\Ug]nYX`]b` Hci WX 6]ghfc"Wca ž`H]_Hc_ gʻVYbYZ]hgʻ]bWi XY`XfUk]b[`]b`bYk W ghca Yfgʻh\fci [\`WUdh]j Uh]b[`j]XYc`WcbhYbhž`cWU`]nYX YI dcgi fYž'UbX`Yb\UbWYX`Yb[U[Ya Ybh_U``k]h\ci h`\YZhm

WfYUh]jY`g\cfh!Zcfa`j]XYcg"

fYghUi fUbhg" J]XYcg'h\Uh'ZYUhi fY'Xfcc`!k cfh\m'ZccXži b]ei Y'a Ybi]hYa gžcf'Yj Yb'h\Y'VY\]bX!h\Y!gWYbYg'\i gh`Y']b'h\Y'_]hW\Yb'WUb dfca dh'U'j]VfUbh'k Uj Y'cZ']bhYfYgh": cf'Yl Ua d`Yž'))ı 'cZ'H]_Hc_ i gYfg'fYdcfhYX'X]b]b['Uh'U'fYghUi fUbh'g]a d`m'VYWUi gY'h\Ym'gUk UddYU`]b['ZccX'WcbhYbh'cb'h\Y'd`UhZcfa "'5g'fYghUi fUbhg'i h]`]nY H]_Hc_'Zcf'a Uf_Yh]b[ž']hg'WYUf'h\Uh'h\YfY g'U'XmbUa]W cddcfhi b]hm'hc'WcbbYWh'k]h\'W ghca Yfg'h\fci [\'fY`UhUV`Y'UbX

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