

ARTS3570

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7 ci fgY[·]Cj Yfj]Yk

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7cbj Ybcfg

BUa Y	9a U]`	5j U]`UV]`]m	@cWUhjcb	D∖cbY
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@cWUhjcb. `GW&cc``CZJWYžA cfj Yb`6fck b`6i]`X]b[ž@Yj Y``&ž&),

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5 hhybXUbWY F Yei]fYa Ybhg

5 'ghi XYbh]g'YI dYWYX'hc'UhYbX'U```WUgg'WcbhUWi\ci fg'Zcf'U'ZJWY!hc!ZJWY'fI &: Ł'cf'V`YbXYX'Wci fgY'UbX Wca d`YhY'U```UWjj]h]Yg'Zcf'U'V`YbXYX'cf'Z ``micb`]bY'Wci fgY"

5 'gh XYbrik \c'Uff]j Ygʻa cfYʻh\Ubʻ%) 'a]bi hYgʻ`UhYʻa UmVYʻdYbUʻ]gYX'Zcfibcb!UhhYbXUbWY"'=Zgi W\ʻUʻdYbUʻhm]gʻ]a dcgYXž'h\Yʻgh XYbria i ghVYʻ]bZcfa YXʻj YfVU``m'Uh'h\YʻYbXʻcZWUggʻUbXʻUXj]gYXʻ]bik f]hjb[iik]h\]bi&(\ci fg"

ZUʻgh XYbhYl dYf]YbWrgʻ]`bYggža]gUXj Ybh fYʻcfʻch YfʻcVWrffYbWrfh Uha U_YgʻUVgYbWrZfca ʻU WUgg#UWfjj]mi bUj c]XUV`Yžcf`Yl dYWrgʻhc`VYʻUVgYbhZfca ʻUʻZcfh Wća]b[ʻWUgg#UWfjj]mžh Ymg\ci `XʻgYY_ dYfa]gg]cbʻZfca ʻh\Yʻ7 ci fgYʻ5i h\cf]mžUbX`k \YfYʻUdd`]WUV`Yžh\Y]f`fYei Yghg\ci `X`VY`UVWća dUb]YX`VmUb cf][]bU`cf`Wrfh]ZJYX`WcdmicZUʻa YX]WU``Wrfh]ZJWUHYʻcf`ch\Yf`Zcfa `cZUddfcdf]UHY`Yj]XYbWr"

5 '7 ci fgY '5 i h\cf]hma UmYI W gY Uʻgh XYbhZrca 'WUggYgʻcfʻUWfjj]hjYgʻZcfʻi dʻhcʻcbY a cbh\"' < ck Yj Yfžh Ym a UmUgg][bʻUXX]hjcbU``UbX#cfʻU`hYfbUhjj YʻHUg_gʻhcʻYbgi fY Wca d`]UbWY" 5 '7 ci fgY '5 i h\cf]hmWcbg]XYfjb['h\Y [fUbhjb['cZUVgYbWY a i ghVYʻgUhjgZjYX Uʻgh XYbhk]``ghj``VY UV`Y hcʻa YYhh\Y Wci fgY'gʻYUfb]b['ci H\car{yg} UbX#cfʻj c`i a Y`cZ`YUfb]b["'5 'gh XYbhgYY_]b['Uddfcj U``hc`VY`UVgYbhZcf`a cfY`h\Ub`cbY`a cbh\`a i ghUdd`m]b`k f]hjb['hc`h\Y`8 YUb`UbX'dfcj]XY`U``cf][]bU``cf`Wffh]ZjYX`gi ddcfhjb['XcW a YbhUh]cb"

: cfa cfY`]bZcfa Uh]cb`UVci hh\Y`UhhYbXUbWY`dfchcWc`g`]b`h\Y`: UW``hmicZ5fhg`UbX`GcW]U` GW]YbWYg.`<u>\hhdg.#k k k "Ufhg"i bgk "YXi "Ui #W ffYbhIghi XYbhg#UWUXYa]W]bZcfa Uh]cb#JfchcWc`g![i]XY`]bYg#</u>

5WUXYa]W=bZcfaUh]cb[.]

: cf`YggYbh]U``ghi XYbh]bZcfa Uh]cb`fY`Uh]b[`hc.`fYei Yghg`Zcf`YI hYbg]cb/fYj]Yk`cZa Uf_g/cVWV dUh]cbU``\YU`h UbX`gUZYhm'YI Ua]bUh]cb`dfcVWXi fYg/gdYV]U``Wcbg]XYfUh]cb`]b`h\Y`Yj YbhcZ]``bYgg`cf`a]gUXj Ybhi fY/ ghi XYbhYei]hmUbX`X]gUV]`]hm'UbX`ch\Yf`YggYbh]U``UWUXYa]W]bZcfa Uh]cbž gYY`<u>\hdg.#k k k "Ufhg"i bgk "YXi "Ui #W ffYbhIgh XYbhg#UWUXYa]W]bZcfa Uh]cb#dfchcWc`g![i]XY`]bYg#</u>

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8YHJ]`g.; fUa a Uf``UggYgga Ybh']b`&`dUfhg`f&\$!' \$`a]bi hYgŁH\]g`UggYgga Ybh']g`VUgYX`i dcb`fYj]g]b[[fUa a Uf`UgdYWfg`cZGdUb]g\`UbX`]g`XcbY`j]U`cb`]bY`]b!WUgg`[fUa a Uf`ei]nnYg''`: YYXVUW_`cb`]bY

5XX]h]cbU``XYhJ]`g.

E i]n '%]b 'k YY_ '* 'ž'E i]n '&]b 'k YY_ '&'

ʿŧð WUgg UggYgga Ybhžghi XYbhgʻi bXYf bc WjfW a ghUbWfg UfY U``ck YX hc hU_Y h\Y hYgh ci hg]XY cZ h\Y``Ub[i U[Y``UVcfUhcf]Yg UbX k]h\ci hhi hcfg gi dYfj]g]cb

H\]gʻUggYgga Ybhi]gʻVUgYXʻcbʻ[fUa a UfʻUgdYWgžj cWUVi `UfmžYI dfYgg]cbgžYHW```YUfbYX``Xi f]b[``YWi fYg UbX`]gʻXcbY`j]U`&`cb`]bY`]b!WUgg`[fUa a Ufžj cWUVi `UfmžfYUX]b[`Wca dfY\Ybg]cb`ei]nnYg"H\Y ei]nnYg`k]```\Uj Y`Ha Y`WcbgHfU]bhg"`6YZcfY`Xc]b[`YUW\`ei]nž]h]gʻfYWca a YbXYX`hc`a U_Y`i gY`cZh\Y YI HYbg]j Y`gYhcZk YY_`m[fUa a Uf`dfUWjWY`YI YfVjgYg`UbX`UWjj]h]Ygʻdfcj]XYX`]b`A ccX`Y`f@YWi fY`gYWjcbŁ

Hifb]h]bgYhh]b[.*

8YHJ]`g. `H\]g`]g`h\Y`Z]bU``UggYgga YbhZcf`UHYbXUbWY`di fdcgYg"`5`fYUX]b[`Wca dfY\Ybg]cb``UbX k f]h]b["f(\$\$`k cfXgŁ YYXVUW_.`a Uf_`cb`m

5XX]h]cbU``XYhJ]`g.

=b`k YY_'% `mci f``YWi fYf`k]```WcbXi WiUb`UggYgga YbhcZmci f`fYUX]b[`UbX`k f]h]b[`UV]`]h]Yg`]b`GdUb]g\"`H\]g UggYgga Ybhk]```WcbHU]b`hk c`dUfhg/cbY`U`fYUX]b[`Wca dfY\Ybg]cb`gYhcZei Ygh]cbg`UbX`dUfhhk c`U`k f]h]b[UWh]j]mn"`H\Y`WcbhYbhcZVch`gYWi]cbg`k]```fYZYWithY`WcbhYbh`YUfbYX`Xi f]b[`thY`gYa YghYf"

Hi fb]h]b`gYh]b[.`H\]g`]g`bchU`Hi fb]h]b`Ugg][ba Ybh

Gi Va]gg]cb cZ5ggYgga YbhHUg_g

Ghi XYbhg UfY YI dYWYX hc di hh\Y]f bUa Yg UbX ghi XYbhbi a VYfg cb Yj YfmdU[Y cZh\Y]f Ugg][ba Ybhg"

Hi fb]h]b Gi Va]gg]cb

Zmci YbWci bhYf'U'dfcV'Ya 'k \Yb'UthYa dhjb['hc'gi Va]hmci f'Ugg][ba Ybht\fci [\'Hi fb]hjbž'd'YUgY hY'Yd\cbY'9I hYfbU''Gi ddcfhicb'-',) '' ' %cf'Ya U]`'h\Ya 'cb'<u>YI hYfbU'hY'hgi ddcfh4 i bgk "YXi "Ui</u>"'Gi ddcfh \ci fg'UfY', .\$\$Ua '-'%\$.\$\$da 'cb'k YY_XUmg'UbX'-.\$\$Ua '-') .\$\$da 'cb'k YY_YbXg'fl *) 'XUmg'U'mYUfŁ'' Zmci UfY'i bUV'Y'hc'gi Va]hmci f'Ugg][ba YbhXi Y'hc'U'ZJi `hk]h\'Hi fb]hjb'mci 'a UmUdd`m'Zcf'Ub'YI hYbg]cbžVi hmci a i ghfYhU]b'mci f'hjW_Yhbi a VYf'Zfca '9I hYfbU''Gi ddcfhfU'cb['k]h\ 'Ubmch\Yf'fY'Yj UbhXcW a YbhgŁ'hc]bWi XY'Ug'Yj]XYbWY hc'gi ddcfhimci f'YI hYbg]cb'Udd`]WUhjcb'' Zmci 'Ya U]`'9I hYfbU''Gi ddcfhimci 'k]`` Ui hca UhjWU'`mfYWY]j Y'U'hjW_Yhbi a VYfž'Vi h]Zmci 'hY'Yd\cbY'mci 'k]``bYYX'hc'gdYWJZWU'`mUg_'Zcf'cbY" Hi fb]hjb'U`gc'dfcj]XYg'i dXUhYg'cb'h\Y]f'gmghYa 'gfUh g'cb'Hk]hYf"

; YbYfU``mž'UggYgga YbhiHUg_g'a i ghVY'gi Va]HHXXYYWYfcb]WU``mj]U'Y]H\Yf'Hi fb]h]b'cf'U'A ccX`Y Ugg][ba Ybh''=b`]bgHUbWYg'k \YfY'H\]g']g'bchdcgg]V`Yž']hk]``VY'gHUHX'cb'mci f'Wci fgY'g'A ccX`Y'g]HY'k]H\ U`HYfbUh]j Y'gi Va]gg]cb'XYHU]`g''

@UhY 5ggYgga Ybh DYbU`h]Yg

5b'UggYggYX'HUg_']g'XYYa YX'`UHY']Z]h']g'gi Va]HYX'UZHYF'H\Y'gdYWJZJYX'Ha Y'UbX'XUHY'Ug'gYhici h']b'H\Y Wci fgY'@YUfb]b['A UbU[Ya Ybh'GmghYa 'f@A GŁ''

H\Y``UhY`dYbU`hm`]g`h\Y``cgg`cZ)ı `cZh\Y`hchU``dcgg]V`Y`aUf_g`Zcf`h\Y`hUg_`Zcf`YUW\`XUmcf`dUfhih\YfYcZh\Y kcf_`]g``UhY"`@UhYbYgg`k]```]bWiXY`kYY_YbXg`UbX`diV`]W\c`]XUmg"`H\]g`XcYg`bch'Udd`mhc`U`hUg_`h\Uh`]g UggYggYX`Vihibc`aUf_`]g`UkUfXYX"

K cf_'gi Va]httX:Zci fhtYb`f%(EXUmg`UZhYf`h\Y`Xi Y`XUhY`k]``VY`a Uf_YX`UbX`ZYYXVUW_`dfcj]XYX`Vi hbc`a Uf_ k]``VY`fYWcfXYX''`=Zh\Y`k cf_`k ci `X`\Uj Y`fYWY]j YX`U`dUgg`a Uf_`Vi hZcf`h\Y``UhYbYgg`UbX`h\Y`k cf_`]g`U Wca di `gcfmWci fgY`Wca dcbYbhzU`gh XYbhk]``VY`XYYa YX`hc`\Uj Y`a Yhh\UhfYei]fYa Ybh'`H\]g`XcYg`bch Udd`mhc`U`hUg_`h\Uhi]g`UggYggYX`Vi hbc`a Uf_`]g`Uk UfXYX''

K cf_`gi Va]hhYX'hk YbhnicbY'f&&:XUmg'UZhYf'h\Y'Xi Y'XUhY'k]``bch'VY'UWW/dhYX'Zcf'a Uf_]b['cf'ZYYXVUW_ UbX'k]``fYWY]j Y'bc'a Uf_`cf'[fUXY"'=Zh\Y'UggYgga Ybh'hUg_`]g'U'Wca di `gcfm'Wca dcbYbhicZh\Y'Wci fgY'U ghi XYbh'k]``Ui hca Uh]WU``m'ZU]``h\Y'Wci fgY"

GdYWJU``7cbg]XYfUh]cb`5dd`]WUh]cbg

 $\label{eq:milling} \end{tabular} Mci `WUb`Udd`millingYgdYWJU`Wcbg]XYfUh]cb`k \Yb`]``bYgg`cf`ch\Yf`WJfW a ghUbWfg`]bhYfZYfY`k]h\`mci f UggYgga YbhidYfZcfa UbWf"$

G]W_bYggža]gUXjYbhifY`cf`ch\Yf`W]fW a gHubWfg`VYmcbX`mcif`Wcbhfc``aUm

ł DfYj Ybhimci i Zfca i Wca d`Yhjb[i U Wci fgY i fYei]fYa Ybhž

ł?YYdimci Zfca UHYbX]b[Ub'UggYggUVYYUW]j]mž

ł Ghod moi i gi Va]hh]b[iUggYggUV Y k cf_iZcfiU Wci fgYž

ł `G][b]Z]WUbhmUZYWimci f`dYfZcfa UbWi`]b`UggYggUV`Y`k cf_ž`VY`]hU`Zcfa U``YbX!cZigYa YghYf`YI Ua]bUh]cbž`U WUgg`hYghž`U``UVcfUhcfmhYghž`U`gYa]bUf`dfYgYbhUh]cb`cf`Ubmich\Yf`Zcfa `cZUggYgga Ybh'

: cf'Z fh\Yf'XYHJ]`g`]b`fY`UH]cb`rc`GdYW]U``7 cbg]XYfUH]cb`]bWi X]b[`''K \Yb`rc`5dd`mf'Z''<ck`rc`5dd`mf'UbX "Gi ddcfh]b[`8cW a YbHJh]cb"'d`YUgY`fYZYf'rc'h\Y`GdYW]U``7 cbg]XYfUH]cb`rk YVgh]Y.` \hhdg.##gh XYbH'i bgk "YXi "Ui #gdYW]U`!Wcbg]XYfUH]cb

5WUXYa]W<cbYghmUbX^D`U[]Uf]ga

D`U[]Uf]ga `]g`i g]b['h\Y`k cfXg`cf`]XYUg`cZch\Yfg`UbX`dfYgYbh]b['h\Ya `Ug`mci f`ck b"`+i\WUb`hU_Y`a Ubm Zcfa gžZfca `XY`]VYfUhY`W\YUh]b['hc`UVW]XYbhU``mWcdm]b['Zfca `U`gci fWf`k]h\ci hUW_bck `YX[Ya Ybh'

IBGK [fcidgidiU[]Uf]ga]bhcih,YiZciick]b[WUhY[cf]Yg.

7 cdm]b[..i g]b['h\Y`gUa Y`cf`j Yfmig]a]`Uf`k cfXg`hc`h\Y`cf][]bU``hYI h`cf`]XYU`k]h\ci hUW_bck `YX[]b['h\Y gci fWY`cf`i g]b['ei chUh]cb`a Uf_g"`H\]g`U`gc`Udd`]Yg`hc`]a U[Ygž`Ufh`UbX`XYg][b`dfc`YWngž`Ug`k Y```Ug dfYgYbhUh]cbg`k \YfY`gca YcbY`dfYgYbhg`Ubch\Yf`g`]XYUg`cf`k cfXg`k]h\ci hWfYX]h"

=ðUddfcdf]UhY`dUfUd\fUg]b[.`W\Ub[]b[`U`ZYk`kcfXg`UbX`d\fUgYg`k\]`Y`acghmfYhU]b]b[`h\Y`cf][]bU` ghfi Whi fY`UbX`]bZcfa Uh]cb`k]h\ci hUW_bck`YX[YaYbh''H\]g`U`gc`Udd`]Yg`]b`dfYgYbHUh]cbg`k\YfY`gcaYcbY dUfUd\fUgYg`Ubch\Yf`g`]XYUg`cf`kcfXg`k]h\ci hWfYX]h''=hU`gc`Udd`]Yg`hc`d]YW]b[`hc[Yh\Yf`ei chYg`UbX dUfUd\fUgYg`]bhc`U`bYk`k\c`Yž`k]h\ci hfYZYfYbW]b[`UbX`U`gh XYbhg`ckb`UbU`mg]g`hc`Vf]b[`h\Y`aUhYf]U` hc[Yh\Yf"

7 c``i g]cb. 'k cf_]b['k]h 'ch Yfg'Vi hdUgg]b['cZh Y'k cf_'Ug'U'dYfgcb'g']bX]j]Xi U``k cf_''7 c``i g]cb'U`gc]bWi XYg'dfcj]X]b['mci f`k cf_'hc'Ubch Yf'gh XYbhVYZcfY'h Y'Xi Y'XUhYzcf'Zcf'h Y'di fdcgY'cZh Ya d`U[]Uf]g]b['UhUbmh]a Yž'dUm]b['Ubch Yf'dYfgcb'hc'dYfZcfa 'Ub'UWUXYa]WhUg_ž'ghYU`]b['cf'UWei]f]b[Ubch Yf'dYfgcb'g'UWUXYa]Wk cf_'UbX'Wcdm]b[']hz'cZYf]b['hc'Wca d`YhY'Ubch Yf'dYfgcb'g'k cf_'cf'gYY_]b[dUma YbhZcf'Wca d`Yh]b['UWUXYa]Wk cf_''

=ðUddfcdf]UhY`W]hUh]cb. 7]h]b[`gci fWYg`k \]W\`\Uj Y`bchVYYb`fYUXžk]h\ci hUW_bck`YX[]b[`h\Y`″gYWcbXUfm´ gci fWY`Zfca`k \]W\`_bck`YX[Y`cZh\Ya`\Ug`VYYb`cVHJ]bYX"

8id`]WUhjcb`fl´gY`Zld`U[]Uf]ga ″Ł`gi Va]hhjb[`mcif`ckb`kcf_ž`]b`k\c`Y`cf`]b`dUfhž`k\YfY`]h\Ug`dfYj]cig`m VYYb`dfYdUfYX`cf`gi Va]hhYX`Zcf`Ubch\Yf`UggYggaYbhcf`WcifgY`UhIBGK`cf`Ubch\Yf`ib]jYfg]hm"

7 cffYWhifYZYfYbWjb[dfUWhjWYg.

- DUfUd\fUg]b[žigi a a Uf]g]b[žiYggUmik f]h]b['UbX'h]a Yia UbU[Ya Ybh
- 5ddfcdf]UhY i gY cZUbX Uhhf]Vi h]cb Zcf U fUb[Y cZa UhYf]U g]bWi X]b['hYl hž]a U[Ygž Zcfa i `UY UbX WcbWYdhg" % Y k c BGK h\Y X

€x]j]Xi U``Ugg]gHJbWY`]g`Uj U]`UV`Y`cb`fYei YghZfca `H\Y`@YUfb]b[`7 YbHfY`f<u>\hd.#k k k "`Wi bgk "YXi "Ui #</u>" Ghi XYbhg`UfY`U`gc`fYa]bXYX`h\U Ub``

% DU%

• VYHYfa UbU[Y'mcifh]a Y

7 ci fgY GVX YXi `Y

<u>J]Yk 'WUgg'h]a YHJV`Y</u>

H]a YHJV`Y'

8 UHY	HmdY	7 c bhYbh
K YY_`%`&*`: YVfi Ufm!`(A UfVX		DfYgYbHUW)Î b`XY``Wîfgc'Y`]bHfcXî WW)Î b'U``W]bY"'fA]fU A ccX`Y`dUfU`]bZcfa UW]Î b`XYHU``UXU`XY``Ug UWM]j]XUXYg`XY`YgHU`gYa UbUŁ
		FYWYYfXU'dUfh]W]dUf'Yb'Y``Zcfc'YghU'gYaUbU UbhYg'XY']f'U``U``YWhifU
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k yy_`&.`) `A Ufvx '!`%% A Ufvx		fA]fU'A ccX`Y'dUfU']bZcfa UWji b`XYHU``UXU'XY``Ug UWjj]XUXYg'XY'YgHU'gYa UbU'mdUfU'Wca d`YHJf dfYdUfUWji b``YWi fUŁ
		@U`bUffUWjÏ`bž``cg`W'Ybhcg`XY`\UXUg
		=bHfcXiVW)Ĩb'U``U'dY`ÉW`U'9``@UVYf]bhc'XY``:Uibc'm YgWfbU'%"'7caYbHJacg'jcWJVi`Uf]cž'YIdfYg]cbYgž W`hifU"
		5i X]cj]gi U``%flWca d`YhJ`UbhYg`XY``U`dfÏ I]a U h hcffUŁ
K YY_'' .'‰'A UfVX'!'% A UfVX		fA]fU`A ccX`Y`dUfU`]bZcfa UW]Î b`XYHJ``UXU`XY``Ug UW]j]XUXYg`XY`YgHJ`gYa UbU`mdUfU`Wca d`YHJf dfYdUfUV]Ĵ b``YWH fUŁ
		@UgʻYacWjcbYg. AÖg]₩Jʻm₩c`cfYg
		'9``@UVYf]bhc`XY``: Ui bc`Yg₩bU`& hi hcfÉJ"7 ca YbhJa cg`j c₩JVi `Uf]cž`YI dfYg]cbYgž W`hi fU"
		9gHJ`gYa UbU`Ya d]YnUb``Ug`gYg]cbYg`XY`cb`]bY WcUWX]b["8YVYg`Wca d`YHJf`*`gYg]cbYg`dUfU dUgUf`YgHY`Wca dcbYbHY`XY``Wifgc
K YY_`(.`%-`A UfVX`!`&) A UfVX		7 ca d`YHJ`UWNjj]XUXYg`UbHYg`XY``U``YWNi fU"fA]fU A ccX`Y`dUfU`]bZcfa UWji b`XYHU``UXU`XY``Ug UWNjj]XUXYg`XY`YgHU`gYa UbU`Ł
		@U`a Ög]₩U`\]gdUbU
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