



ARTS2066

K f]Ŋb[Zcf h\Y G₩YYb

GYa YghYf'C bY''#'&\$%

: 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>

7ci fgY[·]8YHJ]`g

7 fYX]hDc]bhg[·]*[·]

Gi a a UfmcZhXY7ci fgY

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H\]g`WcifgY`WUb`U`gc`VY`ghiX]YX`]b`h\Y`Zc``ck]b[`gdYW]U`]gUh]cb.5dWSf[hWI_d[f[`Y

H\]gʻWcifgYʻ]bhfcXiWYgʻmciʻhcʻh\YʻghiXmUbXʻdfUWf]WYʻcZghcfmhYʻ``]b[ʻZcfʻgWfYYbʻaYX]U"`≢ik]``dfcj]XYʻmci k]h\`U`ZfUaYkcf_`h\fci[\`k\]W\`hc`fYWc[b]gYʻUbX`Wf]h]WU``mUbU`mgY`_YmY`YaYbhgʻcZh\YʻgWfYYbkf]h]b[dfcWYgg"`H\fci[\`dfUWf]WU``YIYfW]gYgžmciʻk]``VY`UV`Y`hc`XYjY`cd`Z bXUaYbhU``g_]``gʻ]bʻh\Y`UfhcZkf]h]b[Zcfʻh\Y`gWfYYb"`Nci`k]```ghiXmU'jUf]YhmcZgWfYYbkf]h]b[ʻZcfagʻ]bWiX]b[ʻg\cfhZ]`agžZYUhifY`Z]`agʻUbX kf]h]b[ʻZcfʻhY`Yj]g]cb"

5 hh Y Wc b Wi g]c b c Z h]g Wc i fgY h Y gh XY b h k]``VY UV Y hc

%" =XYbhJZmUbX`]a d`Ya YbhH\Y`Z bXUa YbHU``Y`Ya Ybhg`UbX`hYW\b]ei Yg`cZgWfYYbk f]hjb["

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GhcfmiYI YfWjgY	&) ı	%-#\$'#&\$%`\$(.\$\$`DA	%Ž
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5ggYgga Ybh8YHJ]`g

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GHUfh'XUHY.

8YHJ]`g. `&!' `dU[Yg`%%dc]bhZcbh%') `gdUW]b[`ff%\$\$\$!%&\$\$`k cfXgŁGh XYbhg`fYWY]j Y`k f]hYb`ZYYXVUW_ž [fUX]b[`fi Vf]WUbX`bi a Yf]WU``[fUXY`j]U`h\Y`@YUfb]b[`A UbU[Ya YbhGmghYa "

5ggYgga Ybh& DYYf gWf]dh UggYgga Ybh

GHUfh'XUHY.

8YHU]`g. **\$*k cfXg"Ghi XYbhg`UfY`UggYggYX`cb`h\Y]f`gWf]dhUggYgga Ybhž`fUh\Yf`h\Ub`cb`h\Y]f`XfUZh gWfYYbd`Umg"`K_\]`Y`h\]g`HUg_`dfcj]XYg`Ub`YI WY``Ybhicddcfhi b]hm`Zcf`ghi XYbhg`hc`dfcj]XY`dYYf`ZYYXVUW_ž h\Ym`Xc`bchUggYgg`ch\Yf`ghi XYbhfg`k cf_`Zcf`WfYX]h``Ghi XYbhg`fYWf]j Y`k f]hhYb`ZYYXVUW_ž`[fUX]b[``fi Vf]WUbX bi a Yf]WU``[fUXY`j]U`@YUfb]b[``A UbU[Ya YbhGmghYa "

5ggYgga Ybh' . GWf]dhžgmbcdg]g UbX ``c[`]bY

GHUfh'XUHY.

8YHJ]`g. %\$! &&`dU[Y`gWf]dh`%&dc]bh'Zcbh'%') `gdUWjb[``]b`VcffYWfigWf]dHkf]Hjb[`ZcfaUH'`) \$\$`k cfX`gmbcdg]g UbX``c[`]bY''`H\]g`]g`H\Y`ZjbU``UggYggaYbhHUg_"Gh XYbhg`fYWf]j Y`kf]HYb`ZYYXVUW_ž`[fUX]b[`fiVf]WUbX bi aYf]WU``[fUXY`j]U`H\Y`@YUfb]b[`AUbU[YaYbhGmgHYa"

Hi fb]h]b`gYh]b[.`H\]g`Ugg][ba Ybh]g`gi Va]hYX`h\fci [\`Hi fb]h]b`UbX`gh XYbhg`Xc`bchgYY`Hi fb]h]b g]a]`Uf]hmifYdcfhg"

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 Ybhmci Zfca Wcad Yhjb[UWci fgY fYei]fYa Ybhž

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

ł Ghod moi i gi Va]hh]b[iUggYggUV Y k cf_ Zcf U 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"`=hWUb`hU_Y`a Ubm Zcfa gžZca `XY`]VYfUhY`W\YUh]b[`hc`UWW]XYbhU``mWcdm]b[`Zca `U`gci fWY`k]h\ci hUW_bck `YX[Ya Ybh'

IBGK '[fcidg'd`U[]Uf]ga ']bhc'h\Y'Zc``ck]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 h`UW_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`YWhgž`Ug`k Y```Ug dfYgYbhUh]cbg`k \YfY`gca YcbY`dfYgYbhg`Ubch\Yf'g`]XYUg`cf`k cfXg`k]h\ci h`WfYX]h"

=bUddfcdf]UhY'dUfUd\fUg]b[.'W\Ub[]b['U'ZYk 'k cfXg'UbX'd\fUgYg'k \]Y'a cghmfYhU]b]b['h\Y'cf][]bU' ghfi Whi fY'UbX']bZcfa Uh]cb'k]h\ci hUW_bck `YX[Ya Ybh''H\]g'U`gc'Udd`]Yg']b'dfYgYbHUh]cbg'k \YfY'gca YcbY dUfUd\fUgYg'Ubch\Yf'g']XYUg'cf'k cfXg'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'ck b'UbU`mg]g'hc'Vf]b['h\Y'a UhYf]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∖]WX`\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`cVhU]bYX"

8id`]\WUh]cb`fl`gY`ZId`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`\\circf`Ucil BGK `cf`Ubch\Yf`ib]jYfg]hm"

7 cffYWhfYZYfYbW]b[dfUWf]WYg.

• VYHYfa UbU[Y'mcifh]a Y

FYgci fWg

DfYgWf]VYX F Ygci fWyg

BchUjU]`UV`Y

FYWca a YbXYX FYgci fWYg

BchUjU]`UV`Y

7ci fgY'9j U`i Uh]cb'UbX'8Yj Y`cda Ybh

-a U[Y[·]7fYX]h

6cX]Yg'/ "+bHYfZJWYg"&\$%*

7F*=*7CG

7F=7CG'Dfcj]XYf'7cXY.'\$\$\$-,;