



# 7 ci fgY<sup>·</sup>Cj Yfj ]Yk

# `GHJZZ`7cbHJWh`8YHJ]`g`

## '7cbj Ybcfg'

B Ua Y	9a U]`	5j U]`UV]`]m	@cWUhjcb	D∖cbY
>c\b`5Hf]X[Y	,	,	FcVYfh KYVghYf	-',)((,(

## GWXcc`7cbHJWh=bZcfaUh]cb

Fcca " &&ž`Yj Y`' FcVYfhK YVghYf6i ]`X]b[

D\cbY.`f\$&Ł`- ' , ) `( , ) \*

9a U]`. <u>'gUa 4 i bgk "YXi "Ui</u>

K YVg]hY. <u>http://ttdg.#gUa\_"Ufhg"i\_bgk\_"YXi\_"Ui\_</u>

: cf`YggYbhJU``ghi XYbh`]bZcfa UhJcb`fY`UhJb[`hc.`fYei Yghg`Zcf`YI hYbg]cb/fYj ]Yk `cZa Uf\_g/cVWV dUhJcbU``\YU`h UbX`gUZYhm'YI Ua ]bUhJcb`dfcVWXi fYg/gdYVJU``Vcbg]XYfUhJcb`]b`h\Y`Yj YbhcZ]``bYgg`cf`a ]gUXj Ybhi fY/ ghi XYbhYei ]hmUbX`X]gUV]`]hm'UbX`ch\Yf`YggYbhJU``UVUXYa ]W]bZcfa UhJcbž gYY`<u>\hhdg.#k k k "Ufhg"i bgk "YXi "Ui #W ffYbhIghi XYbhg#UVUXYa ]W]bZcfa UhJcb#dfchcVc`g![i]XY`]bYg#</u>

# 7ci fgY 8YHJ]g

# 7 fYX]hDc]bhg \*

GiVYWh5fYU.7`Y/jeZ

Gi a a UfmcZh Y 7 ci fqY

H\]g'Wci fgY'WUb'U`gc'VY'gh X]YX']b'h\Y'Zc``ck ]b[ 'gdYWJU`]gUh]cb.'8[\_ EfgV[We

5hh\YWcbWig]cbcZh\]gWcifgYh\YghiXYbhk]``VYUV`Yhc

&" F Y`UhY'a cXYfb]gh`]hYfUh fY'UbX'Z[`a 'hc'h\Y]f'W `h fU``WcbhYl h '"8fUk WebbYWgebg'VYfkYYb\_Yma\_cXYfb]ghfYI hg'UbX'Zj`a\_g'

%" F YUX'a cXYfb]qh`]hYfUh fY'UbX'Z[`a 'Wf]h]WU``m

("AU\_Y'U'dYfqi Uq]jY'Uf[i a Ybh

HYUWX]b[ GhfUhY[]Yg

qdYYW UbX dfcqY"

@YWhifYg.

HYUWX ]b[ ghfUhY[ ]Yg UbX fUh]cbU`Y.

j]Ykg'UbX'Uf[iaYbhg'cZch\Yfg

H\]gʻWcifgY`]bfcXiW/gʻmci`hc`h\Y`kUjY`cZYIdYf]aYbhUhjcb`]b`h\Y`Ufhg`h\UhikY`\UjY`WcaY`hc`WU```

\_ aVWd [e\_ "8i f]b[ 'h\Y']fghZcfmcf'gc'mYUfg'cZh\Y'lk YbhJYh\'WYbh fnž'hfUX]hJcbU``UfhZcfa g'i bXYfk YbhUb i bdfYW/XYbhYX'dfcW/gg'cZfYj c`i hjcb'UbX']bbcj UhjcbžUg'Ufnjghg'UbX'k fjhYfg'gci [\hifUX]WU``mbYk 'k Umg'hc YI dfYgg h Y YI dYf]YbW cZa cXYfb]m''K Y k ]``Wcbg]XYf h Y k cf\_g cZU fUb[Y cZ]bX]j ]Xi U`9i fcdYUb UbX Bcfh\5aYf]WbbacXYfb]ghkf]hYfg'UbX'Z]`a!aU\_YfgžUg'kY``Ug'YIUa]b]b['gcaYcZh\YaUbmWc``YWj]Y a cj Ya Ybhgž [fci di gW Yg UbX "]ga g" h UhgdfUb[ i d Xi f]b[ h]g dYf]cX" 5 hci W ghcbY cZci f ]bei ]fmk ]` VY h Y j YI YX fY`Uhcbg\]d`VYh YYb "a cXYfb]m" Ug`U`\]ghcf]WD`WcbX]hcb`UbX "a cXYfb]ga "Ug`U`W`h fU` a cj Ya Ybh''K \UhXcYg']ha YUb'hc'VY'a cXYfb3'K \Uh\UddYbg'hc'Ufhk \Yb'hfUX]h]cbU`'VY`]YZg'UbX'k Umg'cZ `]ZY`YbhYf`U`dYf]cX`cZdYfa UbYbhWf]g]g`—`U``dYf]cXžh\Uh]gžk \Yb`"U```h\Uh]g`gc`]X`a Y`hg`]bhc`U]f"3`5bX`XcYg a cXYfb]ghW h fY hYUW i g k Ung hc ZYY Uh\ca Y ]b a cXYfb]mžcf XcYg ]hfYa ]bX i g cZci f U ]YbUh]cb3 i

)": cfa i `UHY`UbX`XYZYbX`Ub`]bXYdYbXYbhdc]bhcZj ]Yk `cb`U`gi V^YWžk \]`Y`HU\_]b[ `]bhc`UWWci bhH\Y

\*" 9a d`cmfYgYUfW(`g\_]``gž`]bWi X]b[ `Z]bX]b[ `Uddfcdf]UhY`gYWcbXUfma UhYf]U``UbX`i g]b[ `]hWf]hWU``m'

@YWhifYgžhihcf]U`g`UbX`UggYggaYbhi]b`h\]g`WcifgY`g\ci`X`[]jY`mci`h\Y`g\_]``g`bYWfggUfmhc`dYfZcfa ]bh/``][Ybhž]bXYdYbXYbhfYUX]b[g'cZacXYfb]ghhYI hg'UbX'hc'Wcaaib]WUhY'h\cgY'fYUX]b[g']b'Wc[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'gdYW]ZJYX'Ha Y'UbX'XUHY'Ug'gYhici h']b'H\Y Wci fgY'@YUfb]b['A UbU[Ya YbhGmghYa '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\`XUm`cf`dUfhih\YfYcZh\Y kcf\_`]g``UhY"`@UhYbYgg`k]```]bWiXY`kYY\_YbXg`UbX`diV`]W\c`]XUmg"`H\]g`XcYg`bchUdd`mhc`U`hUg\_`h\Uh`]g UggYggYX`Vihbc`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[ UbUggYggUVYUW]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'

I BGK '[fci dg'd`U[]Uf]ga ']bhc 'h\Y'Zc``ck ]b[ 'WUhY[cf]Yg.

7 cdm]b[..i g]b[.ih,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[.ih,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`YWfgž`Ug`k Y```Ug dfYgYbhUh]cbg`k \YfY`gca YcbY`dfYgYbhg`Ubch\Yf`g`]XYUg`cf`k cfXg`k ]h\ci hWfYX]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

# 7 ci fgY GWX YXi `Y

# <u>J]Yk WUgg'hja YHJV`Y</u>

# H]a YHJV`Y'

8 UHY	Hmd Y	7 c bhYbh
K_YY_`%`&*`: YVfi_Ufmi!`(	@YWhifY	DUfh'%
a ufvx		
		=ðhfcXi Wnjcb.`a cXYfb]ga ža cXYfb]hmžUj Ubh![UfXY`
		DUfh'&
		G`UZ[W`S`VS?aggWfYYb]b['Ž`YWfifY#X]gW`gg]cb
K YY_`&.`) `A UfWX '!`%% A UfWX	@YWMifY Hihcf]U`	AUf]UbbY'AccfYžgY`YWYX'dcYag
		=bhfcXiWhjcb"`6UiXY`U]fYž″≕\UjY`acfY`aYacf]Yg h\Ub`]Z≕kYfY`cbY`h\cigUbX`mYUfg`c`X″`fgYY`AccX`YŁ
I		ļ]

	Hihcf]U`	JYfhcjž?S`i[fZS?ah[W5S_W65f%&+Ł	
K YY_``' \$`5df]`'!`*`A Un	n @YWhifY	K cc`Z:Fa fZW>[YZfZageW	
	Hihcf]U`	7 cbfUXž ~H\Y GYWfYhG\UfYf ~	
K_YY_`%\$.`+`A_Um!`% A_Um	GWFYYb]b[	: [daeZ[_S_a`3_agdfgWfYYb]b[Ł	
	Hihcf]U`	K cc`ZiFa fZW>[YZfZageW	
K_YY_`%%`%(`A_Um!`&\$ A_Um	@YWhi fY	: [daeZ[_Sł?a`3_agdźX]f"`FYgbU]g`fIYWhifYŁ	
	Hi hcf]U`	: [daeZ[_S_a`3_agdf%)-Ł	
K_YY_`%&.`&%`A_Um'!`&+ A_Um	@YWhi fY	@JhY`a_cXYfb]ghdcYhfm`>c\b`5g\VYfmŽ`>cf]Y ;_fU\Ua	
	Hi hcf]U`	>c\b`5g\VYfmžgY`YWYX`dcYag	
K YY_`% .`&, `A Um!'' >i bY	Hi hcf]U`	>cf]Y`; fU\Ua žgY`YWYX`dcYa g`Ž`Wci fgY`cj Yfj ]Yk	

# FYgci fWg

## DfYgWf]VYX F Ygci fWYg

### DcYhfm

>c\b`5g\VYfmžgY`YWhYX`dcYag`fdcYag`gYhZcf`X]gWigg]cb`UfY`]bX]WUhYX`cb`AccX`YŁ

H"G"`9`]chž'FZWI SefW>S`V

>cf]Y'; fU\Ua ž'gY`YWYX'dcYa g`fdcYa g`gYhZcf`X]gW gg]cb'UfY`]bX]WUHYX'cb'A ccX`YŁ

A Uf]UbbY'A ccfYžgY'YWYX'dcYa g'fdcYa g'gYhZcf'X]gW gg]cb'UfY']bX]WUHYX'cb'A ccX'YŁ

BcjY`g`fdifW\UgY`Zfca 'h\Y`IBGK 'Vcc\_g\cdŁ

: cfX'AUXcl : cfXžFZW9aaVEaV[Wdf%-%)Ł

J]f[]b]U`K cc`ZzFafZW>[YZfZageWf% &+Ł

: ]`a g`fgWfYYbYX`]b``YWfi fYg`UbX`Uj U]`UV`Y`]b`f\Y``]VfUfmŁ

G`UZ[W S`VS′agʻfbiĺiY``UbX'8U`É'f%-&-Ł

FZWBSee[a` aX<aS` aX3dJ fB fYmYfŁ'f%- &, Ł

? S` i [fZ S ? ah[W5 S\_ WdS fJ Yfhcj Łf1% &+Ł

: [daeZ[\_S\_a`3\_agdfFYgbU]gŁf%-)-Ł

FYWca a YbXYX<sup>-</sup>FYgci fWYg

GYY'A ccX`Y'Zcf'UXX]h]cbU``fYgci fWfg"

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

A cghWca a YbhgʻhYbX'hcʻVYʻUVci hh\YʻgmʻUVi g"ʻH\YfYfgʻVYYbʻgca YʻfYg]ghUbWYʻhcʻUʻbcj Y`ʻh\Uhk Yʻi gYX'hc ghi Xmcbʻh\]gʻWci fgYžʻ9`]nUVYh\ʻ6ck YbfgʻFZW: WSfaXfZW6Skł gcʻ=fa'ʻYUj ]b[ʻ]hci hh\]gʻmYUf"ʻGca Y ghi XYbhgʻ\Uj YʻYI dfYggYXʻUʻXYg]fYʻhcʻghi Xma cfYʻ″WUgg]Wʻcfʻ″WUbcb]WU`″a cXYfb]ghik f]hYfgžgcʻk YʻUfY Xc]b[ʻH"G"ʻ9`]chih\]gʻmYUfʻ]bghYUXʻcZK "< "ʻ5i XYb"

gYa YghYfž']bWi X]b[`dfYdUfUh]cbžUggYgga Ybhg`UbX`WcbhUWi\ci fg"`A Ubmighi XYbhg`Xc`a cfY`h\Ub`h\]g a ]b]a i a "`=i bXYfgHUbX`h\Uhih\YfY`a ][\hVY`cbY`k YY\_`]b`h\Y`gYa YghYf`k \Yb`mci `WUb'h`]b]g\`h\Y`fYUX]b[" 6i hd`YUgY`fYa Ya VYf`h\Uhimci `g\ci `X`VY`gdYbX]b[`Sf MSef`%\$`\ci fg`U`k YY\_`cb`h\]g`Wci fgYž'UbX`=YI dYWh mci `hc`gdYbX`U``chicZh\Uhih]a Y`fYUX]b["

### -a U[Y<sup>·</sup>7fYX]h

<aS` aX3dJ fX]f"'7 Uf`H\YcXcf'8 fYmYfŁ

#### 7F =7CG

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