

ARTS1010

H∖Y`@]ZY`cZK cfXg

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

7 ci fgY[·]Cj Yfj]Yk

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

'7cbj Ybcfg'

BUa Y	9a U]`	5j U]`UV]`]m	@cWUh]cb	D∖cbY
GhYd\Ub]Y`6]g\cd	GhYd\Ub]Y"6]g\cd4 i bgk "YXi "Ui	Hi YgXUm'&.' \$!&	FcVYfh KYVghYffcca &\$(

"Hihcfg"

B Ua Y	9a U]`	5j U]`UV]`]m	@cWUhjcb	D∖cbY
5bbU ⁻ 8ci[`Ugg	U"Xci [`Ugg4 i bgk "YXi "Ui			
>Ua Ygʻ6YXZcfX	∿a Yg"VYXZcfX4 i bgk "YXi "Ui			
>Ua Ygʻ8i Hhcb	∕*Xihhcb4 i bgk "YXi "Ui			

GWXcc``7cbHJWhi=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>htdg.##gUa "Ufhg"i bgk "YXi "Ui</u>

H\Y'GW\cc``cZh\Y'5fhg'UbX'AYX]U'k ci `X``]_Y'hc'FYgdYWbZ ``m5W_bck `YX[Y'h\Y'HfUX]h]cbU``7ighcX]Ubgž h\Y'6YXY[U``fPYbg]b[hcb'WJa digŁž; UX][U``fD]hm'UbX'5fh/ '8Yg][b'7Ua digYgŁ'UbX'h\Y'B[ibbUk U` dYcd'Y'fБighfU`]Ub'8YZYbW': cfW'5WJXYam']b'7UbVYffUŁ'cZh\Y``UbXg'k\YfY'YUW\'WJa dig'cZIBGK ']g `cWJhYX"

5 HYbXUbWY FYei]fYa Ybhg

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

5 'ghi XYbhik \c'Uff]j Ygʻa cfYʻh\Ubʻ%) 'a]bi hYgʻ`UhYʻa UmVYʻdYbUʻ]gYX'Zcfibcb!UhhYbXUbVW'''=Zgi VX'UʻdYbUʻhm]gʻ]a dcgYXžh\Yʻghi XYbha i ghVYʻ]bZcfa YXʻj YfVU``mUhih\YʻYbXʻcZWUggʻUbXʻUXj]gYXʻ]bik f]hjb[iik]h\]bi&(\ci fg"

ZUʻgh XYbhYl dYf]YbWrgʻ]`bYggža]gUXj Ybh fYʻcfʻch YfʻcVWrffYbWrfh Uha U_YgʻUVgYbWrZfca ʻU WUgg#UWfj]mi bUj c]XUV`Yžcf`Yl dYWrgʻhc`VYʻUVgYbhZfca ʻUʻZcfh Wca]b[ʻWUgg#UWfj]mizh Ymg\ci `XʻgYY_ dYfa]gg]cbʻZfca ʻh\Yʻ7 ci fgYʻ5i h\cf]mizUbX`k \YfYʻUdd`]WUV`Yžh\Y]f`fYei Yghg\ci `XʻVYʻUVWca dUb]YX`VmUb cf][]bUʻcf`WrffjZ]YX`WcdmicZUʻa YX]WU``WrffjZ]WUhYʻcf`ch\Yf`Zcfa cZUddfcdf]UhY`Yj]XYbWr"

5 '7 ci fgY '5 i f\cf]fma UmYI W gY 'U'ghi XYbh'Zica 'WUggYg'cf'UW]j]h]Yg 'Zcf'i d'fc'cbY 'a cbf\"'< ck Yj Yfž'h Ym a UmUgg][b'UXX]h]cbU``UbX#cf'U`f\fbUh]j Y'fUg_g'fc'Ybgi fY'Wca d`]UbW"''5 '7 ci fgY '5 i f\cf]fm'Wcbg]XYf]b['f\Y [fUbh]b['cZUVgYbW' a i gh'VY gUh]gZ]YX'U'ghi XYbhk]``gh]```VY'UV'Y fc'a YYhf\Y'Wci fgY'g 'YUfb]b['ci fWca Yg UbX#cf'j c`i a Y'cZ`YUfb]b[''5 ghi XYbhgYY_]b['Uddfcj U`fc'VY'UVgYbhZcf'a cfY'f\Ub'cbY'a cbf\ a i gh'Udd`m]b'k f]h]b['hc'h\Y'8YUb'UbX'dfcj]XY'U```cf][]bU``cf'Wfh]ZYX'gi ddcfh]b['XcW a YbhUh]cb"

: cfa cfY`]bZcfa Uh]cb`UVci hh\Y`UhhYbXUbWY`dfchcWc`g`]b`h\Y`: UWV`hmicZ5fhg`UbX`GcW]U` GW]YbVWg.`<u>\hhdg.#kkk"Ufhg"i bgk"YXi"Ui #W ffYbh1ghi XYbhg#UWUXYa]W]bZcfa Uh]cb#dfchcWc`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`dfcWYXi fYg/gdYW]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>\hhdg.#k k k "Ufhg"i bgk "YXi "Ui #W ffYbhghi XYbhg#UWUXYa]W]bZcfa Uh]cb#dfchcWc`g![i]XY`]bYg#</u> 7 ci fgY`8YHJ]`g 7 fYX]hDc]bhg`*` H\Y`YWni fY!hi hcf]U``k]``YbWci fU[Y`X]gW gg]cb`UbX`Wf]h]WU``UbU`mg]g`cZkYY_`mfYUX]b[g`k]h\`h\Y YI dYWfUh]cb`h\Uhh\YgY`fYUX]b[g`k]```gYfj Y`Ug`a cXY`g`Zcf`ghi XYbhg`ckb`kf]h]b["`H\Y`YWni fY!hi hcf]U``k]`` U`gc`VY`i gYX`hc`WcbXi Wikf]h]b[`YI YfW]gYg"`H\YgY`k]``YbWci fU[Y`ghi XYbhg`hc`kcf_`]b`bYk`UbX YI dYf]a YbhU``k Umg`i g]b[`U`j Uf]YhmcZdfca dhg`UbX`aYh\cXg"

H\Y'k cf_g\cdg'k]```dfcj]XY'h\Y'cddcfh b]hmZcf'dYYf'[fci d'ZYYXVUW_'cb'gh XYbhfg'ck b'WfYUhj Y'k cf_"'H\Y k cf_g\cd'k]``YbWci fU[Y']bXYdYbXYbh`YUfb]b['UbX'Wf]hWU``fYZYWf]cb'cb'cb'cbYfg'ck b'k f]hjb["'=fik]``U`gc XYj Y`cd'gh XYbhfg'i bXYfghUbX]b['cZh\Y'dfcWfgg'cZfYj]g]b[ž'YX]hjb['UbX'dc`]g\]b['U'd]YWf'cZk cf_"'H\Y gi WWfgg'cZh\Y'k cf_g\cd'XYdYbXg'i dcb']bX]j]Xi U``Yb[U[Ya Ybhk]h\'h\Y'k YY_`ma UhYf]U`/]hfY`]Yg'cb [fci d``YUfb]b['UbX']h]g'YggYbhJU``h\UhYj YfmcbY'UWfj Y`mdUfhJWJdUhY']b'YUW\'k cf_g\cd"

H\Y'UddfcUWX'cZ`YWfi fYfg'UbX'hi hcfg']b'h\Y'Wci fgY']g'[cj YfbYX']b'[YbYfU`'Vm

@YWi fYfg`UbX`hi hcfg`]b`h\Y`Wci fgY`k]``di fgi Y`h\Y`Wci fgY`U]a g`VmXc]b[`gYj YfU``h\]b[g`Ua cb[`k\]W\`UfY.

- •.....dufh]W]dUh]b[`]b`UbX`[i]X]b[`X]gW gg]cb`]b`h\Y`h`hcf]U``UbX`k cf_g\cdg
- dfcj]X]b['kf]thYb'WcaaYbhg'cb'h\Y'kf]thYb'kcf_mci'giVa]h
-VY]b['Uj U]`UV`Y`hc`X]gWigg`k]h\ mci 'h\Y`Wci fgY`UbX`mci f`ghi X]Yg
-ig]b['HYWXb]WU``j cWUVi `Ufmihc X]gWigg'HXYUgg][bYX'HYI hg
- •.....Ug_]b['mci 'hc'k cf_']b'ga U```[fci dg']b'h\Y``YWi fY!hi hcf]U`

5ggYgga Ybh

5ggYgga YbhHUg_g

5ggYgga YbhˈtJg_	K Y][\h	8iY'8UHY	GhiXYbhi@YUfb]b[CihWcaYgʻ5ggYggYX
F YgYUfWX '9ggUm'	&) ı	%)#\$(#&\$% [`] %%() [`] DA	%ž&ž ž(
K f]h]b[K cf_g\cd	&\$1	Cb[c]b[`kYY_`mgi Va]gg]cb	%ž&ž ž)
AU∕cf`7fYUh]jY`Kcf_`))।	\$%#\$*#&\$% `%%()`DA	%ž(ž)

5ggYgga Ybh8YfU]`g

5ggYgga Ybh% FYgYUfW 9ggUm

GHUfhXUHY. Bch5dd`]WUV`Y

@Yb[h\. %) \$\$ A UI]a i a

8YHJ]`g. %) \$\$`k cfXg`a UI]a i a "`GdYW]Z]Wk f]HYb`ZYYXVUW_`cb`]bX]j]Xi U``YggUmgž[YbYfU``cfU``ZYYXVUW_`]b `YWi fY`UbX`h hcf]U`"

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

: cf'h\]g'Ugg][ba Ybhmci 'k]``'i bXYfhU_Y'Wf]h]WU``fYgYUfW\"

$H Y HJg_k] VY Jg Zc c k g.$

7 ca d`YhY`U`Wf]h]WU``YggUmcb`cbY`cZh\Y`hcd]Wg`Wcbg]XYfYX`]b`h\Y``YWfi fYg`VYhk YYb`k YY_g`'`UbX`*"`**9ggUm** ei Ygh]cbg`fY`UhYX`hc`h\YgY`hcd]Wg`k]```VY`dfcj]XYX`]b`k YY_`'#("``H\Y`YggUmg\ci``X`dfcj]XY`U`WcgY fYUX]b[`cZ'U`gY`YWf]cb`cZ'gYh'hYI hg`fIVYhk YYb`cbY`UbX`h\fYY`XYdYbX]b[`cb`h\Y`g]nY`cZ'h\Y`W\cgYb d]YWYgŁ``h\]g``WcgY`fYUX]b[`h\Y`a U]b`cV'YWf]jY`cZ'h\Y`UggYgga Ybh'

=b fk]g YggUmmci 'UfY YI dYWYX hc 'ZcW g cb fk Y YZZYWik YgY d]YW g \Uj Y cb mci 'Ug U fYUXYf 'UbX fk Y dcYh]Wg cZh Y g \cfhghcfm Zcfa . k \Uha U_Yg fk YgY d]YW g k cf_3 K \mUfY fk Ymdck YfZ '3' < ck 'XcYg fk Uh k cf_YZYW imci 'UbX k \m3 K \Uh`]hYfUfm Y Ya Ybhg cf ZYUhi fYg Wcbhf]Vi hY hc fk Y]f YZZYW jj YbYgg3 H\]g UggYgga Ybhk]``XYj Y cd mci fi bXYfgHUbX]b['cZ \ck 'h Y g \cfhghcfm k cf_gž \ck ']hWUb 'VY fU_Yb']b bYk UbX UXj Ybhi fci g X]fYW jcbgž UbX \ck 'WffHJ]b YZYWg UfY 'UW]Yj YX" = ik]``YbWci fU[Y mci 'hc fYZYW icb fk Y g][b]Z]WUbW cZdUff]W 'Uf hY W b]ei Yg UbX 'WfUZhXYMg log ']b fY`Uh]cb hc mci fick b 'WfYUh]j Y k cf_" = i]g YI dYWYX fk Uhik]g Wf]h]WU`_bck 'YX[Y k]``Yb \UbW' mci fi WfYUh]j Y dfUWf]WY " = i]g bchUb YggUmfk UhUg_g mci hc Wca a Ybhcb fk Y gcW]c!W 'hi fU`g][b]Z]WUbW cZUbm[]j Yb d]YW z fUh Yffk Y U]a ']g hc 'Wf]h]ei Y fk Y zcfa U` UbX gmi]gh]WZYUhi fYg]b cfXYf fk i bXYfgHUbX fk Y]f'dck Yf"

5ggYgga Ybh7f]hYf]U.

7 f]h]WU``Uk UfYbYgg. `h\Y`WUdUW]mihc`d`UW##X]gWigg`h\Y`hYI h`]b`U`Wf]h]WU``WcbhYI h 8Ya cbghfUh]cb`cZWf]h]WU``fYZYWf]cb`fh\]g`a Um'YY`]b`fY[UfXg`hc`U`hYI h`cf`WfYUh]j Y`dfUWf]WfžXYdYbX]b[`cb`h\Y ei Ygh]cb`VY]b[`UXXfYggYXŁ 8Ya cbghfUh]cb`cZWf]h]WU``_bck`YX[Y`gi ffci bX]b[`h\Y`gY`YWfYX`hYI h`fbyYWcbXUfmigci fWfgŁ'I bXYfghUbX]b[`cZ \ck`h\Y`fY`Yj UbhidcYh]WY`Ya YbhfbŁ`cdYfUhYg`]b`h\Y`gY`YWfYX`hYI h`fbyYWcVX'VmWcgY`UbU`mg]g#WcgY fYUX]b[g`cZdUggU[Yg`Zfca`h\Y`hYIh Cf][]bU`]miUbX`]b]h]Uh];Y`]b`i`g]b[`fYZYWh];YžUbU`mh]WU``UbX`Wf]h]WU``h\]b_]b[5ddfcdf]UhY`UWUXYa]WfYZYfYbW]b[ž'dfYgYbhUh]cb`UbX`ghmY`fhci``WUb`W\cgY`UbmighmY`mci```]_Yž'gc``cb[`Ug`]h]g`i`gYX`UWW`fUhY`miUbX`Wcbg]ghYbhmŁ"

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"

5ggYgga Ybh& K f]h]b[K cf_g\cd

GHUfhXUHY. Bch5dd`]WUV`Y

@Yb[h.*%\$\$\$*aUl

8YHJ]`g. ʿŧðX]j]Xi U``k cf_g\cdd]b[ʿ1 ʿ%) !&\$ʿa]bgʿŽ ʿk YY_`mik cf_g\cdˈdfYgYbHJHcb''`K f]HYbʿZYYXVUW_`cb XfUZria UHYf]UʿžˈcfU``ZYYXVUW_`]bʿh hcf]U`''

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

5ggYgga Ybh& K f]h]b[K cf_g\cd 8YhJ]`g. H\YfY`UfY`hk c`dUfhg`hc`h\]g`Ugg][ba Ybh`

%Ł' ŧbX]j]Xi U``k cf_g\cdd]b['1 '%) !&\$ a]bg Ž k YY_`mik cf_g\cd'dfYgYbłUh]cb"

&ŁK f]HYbŻYYXVUW_icbXfUZiaUHYf]UiźcfUiiŻYYXVUW_i]bih hcf]UiiiH\]giŻYYXVUW_i]gii bXYfHU_YbiVmimci źi]"Y"i]h]gihYiŻYYXVUW_imci i[]jYihcimci fidYYfgicbihYiWfYUH]jYik cf_ih\Uhih\Ym\UjYigi Va]HYX

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

H\Y`hihcf]U`g`Zcf`h\]g`WcifgY`Z bWgcb`Ug`kf]hjb[`kcf_g\cdg`]b`k\]W\`mcif`WfYUhjjY`kcf_`]g`XYjYa XYjYa XYjYa XYjYa

K \Yb`]h]gʻmci fʻhi fbʻhcʻk cf_g\cdʻdʻYUgYʻYbgi fYʻh\Uhimci fʻdU[YgʻUfYʻbi a VYfYXʻUbXʻmci fʻbUa Y`]gʻcbʻYUVX dU[YʻcZmci fʻd]YV¥"

: cfˈh\Y`fYghcZh\Y`ghiXYbhg`f]"Y"`h\cgY`k \c`UfY`bchik cf_g\cdd]b[`cb`Ubm`[]j Yb`k YY_Łžmci``k]```VY YI dYWYX`hc`fYgdcbX`hc`h\]g`k cf_`Z]fghih\fci [\`U`A ccX`Y`6`c[ž`UbX`h\Yb`hc`X]gW gg`]hk]h\`mci f`dYYfg`]b WUgg"

K \Yb`[]j]b[`ZYYXVUW_.

H\]gʻkf]hhYbʻZYYXVUW_`]gʻYX]hcf]U``hfU]b]b[ʻZcf`mci"`Nciʻg\ci`X`ZcWigʻcb`Y`YaYbhgʻcZh\Y`XfUZnh\Uh'UfY dfcj]b[`YZYWhjjYž'UbX`gYWhjcbg`k\YfY`Zifh\Yf`kcf_`]gʻbYYXYX"`Nci`k]``VY`YIdYWhYX`hc`UXXfYggž'Zcf YIUad`Y.

- %" Glffi WinfU``WebWrfbg`k]h\]b`h\Y`d]YWr`—`UfY`h\Y`hfUbg]h]ebg`VYlk YYb`dUfU[fUd\g`dUfh]W``Uf`mighfeb[cf`UfY`h\Ymide]bhg`k \YfY`Webh]bi`]hmi]g`U`dfeV`Ya 3
- &" @Ub[iU[Y`igY`.`UfY`h\YfY`gdYŴ]Z]ŴgYŴjcbg`cf`d\fUgYg`k]h\]b`h\Y`d]YWY`h\Uh'UfY`YgdYŴ]U``mghf]_]b[ž k\Uh'gYWjcbg`dYf\Udg``UW_`WUf]hm'UbX`bYYX`kcf_3
- ' " C f][]bU``ZYUh fYg. cj YfU``ž'k \Uh]g`i bi gi U``UbX`dck YfZ ``UVci hh\]g`k cf_ž'k \Uh]g`k cf_]b[`fYU``m k Y``3
- ("DfYgYbWFcZUighfcb[i]XYUžh\YaYicfiZYY`]b[.ik\Uhi]gih\]gž\ckikici `Ximci 'Ufh]WiUhYi]h8 5 `hYfbUh]j Yimži]gih\YfYiUbiUVgYbWFcZUighfcb[i]XYUigYYbicfiZYY`]b[3
-) " GYbgY`cZbUffŪhj Y`XYj Y`cd]b[.`k \YfY`]g`h\]g`d]YWY`[c]b[3`K \Uhei Ygh]cbg`XcYg`]hdfcj c_Y3`K \Uh [Udg`gh]``bYYX`hc`VY`Z]``YX3`5g`U`fYUXYfž`k \YfY`UfY`mci `WcbZ gYX3

Mci 'k]```VY'YI dYWYX'hc'k f]hY'Uddfcl]a UhY'm&'hc'' XYHU]`YX'dUfU[fUd\g`]b'fYgdcbgY'hc'YUW\'d]YW'cZ k cf_"'H\YgY'a Um]bWi XY'Vi ``Yhdc]bhg'UbX'a UhYf]U``ei chYX'X]fYWhmZfca 'h\Y'WfYUh]j Y'k cf_"'H\]g'k f]hY'b cb`]bY'ZYYXVUW_']g'dUfhcZmci f'k cf_g\cd'UggYgga Ybh''Nci 'k]``bYYX'hc'Wca d`YhY'h\]g'cb`]bY'ZYYXVUW_'Vm a]Xb][\hcb'h\Y'XUmVYZcfY'h\Y'XUmcZh\Y'h'hcf]U`"'f]"Y"']Zmci f'h hcf]U`"]g'cb'K YXbYgXUmh\Y'ZYYXVUW_ k]``bYYX'hc'VY'Wca d`YhYX'VmHi YgXUma]Xb][\ht"DYbU'h]Yg'k]``'Udd`mhc``UhY'ZYYXVUW_"'

fi]g h Y fYgdcbg]V]`]micZU```ghi XYbhg hc fYUX h YgY a Ubi gWf]dhg VYZcfY WUggžWca a Ybhcb h Ya 'k]h]b h Y V`c[`df]cf hc WUggžUbX Wca Y hc WUgg dfYdUfYX hc YX]hUbX Wf]h]WU``mUggYgg h Y a UhYf]U``]b Z fh Yf XYhU]`" D`YUgY Ybgi fY h Uhmci `\Uj Y Y]h Yf Ub cb`]bY Wcdmicf U`\UfX WcdmicZh Y a UhYf]U``]b WUgg`]b cfXYf hc X]gW gg`]hYZYWhj Y`m"

Mci ^{*}k]^{**}VY YI dYWYX ^{*}hc ^{*}dUfh]W]dUhY ^{*}]b ^{*}j YfVU^{**}X]gW gg]cb ^{*}Xi f]b[^{*}h Y ^{*}h hc f]U^{**}

D@95G9`BCH9`!`Bc`YI hfU`kf]hhYb`ZYYXVUW_`k]``VY`dfcj]XYX`cb`XfUZhaUhYf]U``Vmh\Y hi hcf#WcbjYbcf`VYmcbX`h\Y`kcf_g\cd`gWYbUf]c"`=Z`mci`kci`X``]_Y`Zfh\Yf`ZYYXVUW_`d`YUgY`aU_Y`Ub Uddc]bhaYbhk]h\`h\Y`WcbjYbcf`Xif]b[``h\Y]f`Wcbgi``hUh]cb`\cifg"`6f]b[`mcif`kcf_`k]h\`mci``UbX h\]g`WUb`VY`X]gWiggYX`Uh'h\Y`h]aY"

5ggYgga Ybh7f]hYf]U. K cf_g\cd: YYXVUW_

H\ci [\hz]`žWebghfi Whj YžXYHJ]YX'UbX'Wei fhYci gʻZYYXVUW_'he`dYYfgžXYa ebghfUhjb[`Wf]hjWU``f][ci f`]b`mei f WUdUW]hmiUg`YX]hef 9j]XYbWY`cZWegY`XYHJ]YX`fYUX]b[`cZh\Y`hYI h : YYXVUW_'h\UhjXYbhjZyg`gdYWjZ]Wde]bhg`cZUW\]Yj Ya Ybh#WebWYfb`h\fei [\`h\Y`i gY`cZei chYX`a UhYf]U` 7 UdUW]hmihe`UXXfYgg`h\Y`VfcUXYf`WebWYdhicZh\Y`k cf_ž]hg`cj YfU``UW\]Yj Ya Ybh 7 UdUW]hmihe`JXYbhjZmgdYWJZ]WdfeV`Ya`UfYUg`UbX'degY`ei Ygh]ebg`he`h\Y`Ui h\ef`UVci hih\YgY

5ggYgga Ybh'7f]hYf]U. '8fUZh'7fYUhjj Y'K cf_'

EiU`]micZWfYUhjjY`kcf_`dfYgYbhYX`]"Y"`Yj]XYbWY`cZWfUZig_]``gžcf][]bU`]mžigY`cZ]aU[YgžYach]cbU`]bhY[f]m

: `ck #YUX]b['Wc\YfYbWY. 'HfUbg]h]cbg'VYhk YYb'gYbhYbWYg'UbX'dUfU[fUd\gža cj Ya Ybhk]h\]b'h\Y'd]YWY B UffUh]j Y'XYj Y`cda Ybh'XcYg'h\Y'd]YWY'Vi]`X#Yj c`j Y3'5V]`]hmhc'WfYUhY'W\Ub[Y'k]h\]b'h\Y'd]YWY'GdYW]U` ei U`]h]Yg. `gi W\'Ug'f]g_!HU_]b[ž`\i a ci fži bi gi U``]a U[YgžWca dY``]b['X][fYgg]cb'C f][]bU`]hmUbX']b]h]Uh]j Yž EiU`]micZWfYUh]jY`kcf_`dfYgYbhYX`]"Y"`Yj]XYbWY`cZWfUZrig_]``gžcf][]bU`]mžigY`cZ]aU[YgžYach]cbU`]bhY[f]m

: `ck #YUX]b[`Wc\YfYbWY.`hfUbg]h]cbg`VYhk YYb`gYbhYbWYg`UbX`dUfU[fUd\gža cj Ya Ybhik]h\]b`h\Y`d]YW

BUffUhji Y`XYj Y`cda Ybh`XcYg`h\Y`d]YWY`Vi_]`X#/j c`j Y3`5V]`]mihc`WfYUhY`W\Ub[Y`k_]h\]b`h\Y`d]YWY

GdYWJU``ei U`]hJYg.`gi W.`Ug`f]g_!HJ_]b[ž\i a ci fži bi gi U``]a U[YgžWca dY``]b[X][fYgg]cb

C f][]bU`]lmiUbX`]b]h]Uh]j Yžk]``]b[bYggihc YI dYf]a Ybh I gYicZ`Ub[i U[Y.idfYW]g]cbžVc`XbYggž`nf]W]ga žj]j UW]lm

I gY`cZh]a Y.`\ck`UfY`kY`cf]YbhUhYX`]b`h]a Y3`<ck`]g`h]a Y`i gYX`hc`ghfi Whi fY`h\Y`d]YWY3`9b[U[Ya Ybhk]h\ hcd]W#fYUXYf#Yb[U[]b[`bUhi fY`cZ]XYU 9a ch]cbU``]bhY[f]mž`WUdUW]mihc`Y`]W]hifYgdcbgY GYbgY`cZUi h\Ybh]W]micZX]U`c[i Y`UbX`W\UfUWhYf]nUh]cb`fk\Yb`fY`Yj Ubh2

FYZYWYjcbicbiYiYaYbhgicZW/UZhUbXidcYhjWgiUgiX]gWiggYXi]biYWYifYgiUbXikcf_g\cdg.'WYUfiYj]XYbWYicZ Yb[U[YaYbhik]h\'WcifgYiaUhYf]U`žUbiibXYfgHUbX]b[icZh\]giaUhYf]U` 7UdUW]hmihciXYjYicdiUbXidci]g\incifikcf_ CjYfU```ZcWigicZh\Yid]YWY

FYdfYgYbHJhjcbicZWebgWjeigbYggždfYgYbWYiefigi[[YghjcbicZ]bhYfjef]mžWeffYiUhjebicZWUUfUWhYfik]h Ybj]febaYbhžghfeb[igYbgYicZjc]W/ GYbgYicZ]XYU#YjYbhik\UhiaUhhYfgiacgh3i7UdUWjhmiheidf]ef]hjgY 5hhYadhiheiYIdiefYWeadYIi]XYUgiUbX#efiYIdYf]YbWYgih\fei[\iZefaU``]bbejUhjebi#ef][]bU`]hmiUbXi]b]hjUhjjY

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 XYbhgʻUfYʻYI dYWhYXʻhcʻdi hih\Y]fʻbUa YgʻUbXʻghi XYbhibi a VYfgʻcbʻYj YfmdU[YʻcZh\Y]fʻUgg][ba Ybhgʻ

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

Zmci YbWci bhYf'U'dfcV'Ya 'k \Yb'UhYa dhjb['hc'gi Va]hmci f'Ugg][ba YbhN fci [\ 'Hi fb]hjbž'd'YUgY hY'Yd\cbY'9I hYfbU''Gi ddcfhcb'- ',) '' ' %cf'Ya U]`'h\Ya 'cb'<u>Yl 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'Yl hYbg]cbž'Vi 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 YbhgEhc]bWi XY'Ug'Yj]XYbWY hc'gi ddcfhmci f'Yl hYbg]cb'Udd`]WUh]cb'''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'gdYWJZJWU'`mUg_'Zcf'cbY'' Hi fb]hjb'U`gc'dfcj]XYg'i dXUhYg'cb'h\Y]f'gmghYa 'gfUhi 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 YbhDYbU`h]Yg

5b'UggYggYX'HJg_']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 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`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??YYd.mci Zfca UHHYbX]b[UbUggYggUVYYUWf]]mž

ł Ghod moi i gi Va]hhjb[i UggYggUV 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"`=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

7 ci fgY GWX YXi `Y

<u>J]Yk WUgg'ha YHJV'Y</u>

H]a YHJV`Y'

8 UHY	HmdY	7 c bhYbh
K YY_'%`&*`: YVfi Ufmi!`(=bhfcXiWMjcbihcih∖YWcifgY"
a ufwx		H\]gʻkYY_`mci`k]``VY`]bhfcXiWYX`hc`h\Y`ghfiWhifY UbX`WcbhYbhcZh\]gʻWcifgYžkYfi`UXXfYgg`h\Y`WiffYbh fYj]jU``cZh\Y`g\cfhghcfmiZcfaž`]hfg`dYfjUg]jYbYgg UbX`YIdYf]aYbhU``X]aYbg]cbg"`GcaY`WfYUh]jY kf]h]b[``k]```U`gc`VY`WcbXiWhYX`Xif]b[``h\Y``YWhifY"`Bc fYUX]b[g`h\]g`kYY_"
		D`YUgY`bchY`h\Uhihincf]U`g`VY[]b`]b`K_YY_`&"`H\YfY UfY`bc`hincf]U`g`]b`k YY_`%
K_YY_`&.`) `A_UfVX`!`%% A_UfVX	@YWhifY	7 fYUhjj Y`H\]b_]b[#7 fYUhjj Y`K f]hjb[
		H\]gʻkYY_ʻkYfi``cc_`Uh\ck`UʻghcfmXYjY`cdgžk\YfY WfYUhjjY`]XYUgʻWcaY`Zfca`UbX`h\Y`V`iffYX fY`Uhjcbg\]dʻVYhkYYb`hfih\`UbX`ZJWnjcb"
		FYUX]b[g'ZcibX'cb'AccX`Y.
		FUmacbX'7UfjYf"CbKf]h]b["
		>i`]Y'GW\i a UV\Yf""Hi fb]b[`F YU``@]ZY`]bhc`:]Wf]cb"
		91 hfUWhiZica '5`WXYam`K f]hYfg`cb`Hfi h\ž@]Yg`UbX :]Whjcb
		Ch\Yf`fYUX]b[g`H67
K_YY_'' . '%&'A_UfVX '! '%	@YWhifY	A]b]a U`]ga žHk]h∕fUh fY`UbX`h∖Y`"G`]WrcZ@]Z⁄"
a ufvx		H\]gʻkYY_fogʻ`YWnifYʻk]```UXXfYggʻh\Y`]bZiYbh]U``]XYU cZh\Y`g\cfhighcfmiUgʻUʻfog`]WYʻcZ`]ZYfiUbX h\Y`fY`Y
l		

		>Ybb]ZYf`9[Ubž"6`UW_`6cl" 7`U]fY`@ci]gY!6YbbYhiYIHfUWiZfca`Ba`V 5bbY`7UfgcbžYIHfUWiZfca`EZadfFS1}e 7\Y_\ci`"AlgYfg"
K YY_`(.`% `A UfVX`!`&) A UfVX	@YWA fY	7 \Y_\cj "A]gYfm" 5 Ygh YhjWg cZh Y A i bXUbY UbX hY Gi V]a Y. h Y fc Y cZh Y Yd]d\Ubm]b h Y g\cfhighcfm =b h]g YWi fY k Y k]```cc_'Uhgca Y '_Ymghfi Wi fU` df]bV]d Yg cZ < Y Yb '; UfbYffg g\cfhi2]Wijcbžk]h 'U dUfh]W 'Uf ZcW g cb h Y cf[Ub]g]b['dck Yf cZh Y Yd]d\Ubm' =b h Y gYWcbX'\U ZcZ'YWi fY h YfY k]``VY XYhU] YX X]W gg]cb cZh Y a]X!gYa YghYf fYgYUfW 'YggUm' F YUX]b[g`'cb A ccX'Y. Gi Y K cc ZYžYI WYfdhZca 'A U_]b['Ghcf]Yg

		·
6fYU`&`5df]``!`, `5df]`		
K YY_`*.`-`5df]`'!`%)`5df]`	@Y₩nifY	
		7\UfUWhYf`7cbgW]cigbYgg.` <ck`hc`wcbjym]bbyf `]ZY3`</ck`hc`wcbjym]bbyf
		H\]g`kYY_`H\Y``YWMifY`k]```UXXfYgg`H\Y`ZcfaUH]cb`cZ W\UfUVMYf`UbX`H\Y`kUmg`]b`k\]V\\`]bbYf``]ZY`]g fYjYU`YX`UbX`k]H\\Y`X`Zcf`dUfH]WI`Uf`YZZYWM
		FYUX]b[g'Cb'AccX`Y.
		5bbY`9bf][\h"MYgHYfXUmlg`K YUH\Yf"
		HYggU ⁻ < UX ⁻ Ymž ⁻ H6 7
		?]fghni; i bbžiH67
		; Ycf[Y`GUi bXYfg``fJ]Wcfmi@Udfi
		D@95G9'BCH9.'9ggUm5ggYga YbhXi Y'cb'5df]`'%)
K_YY_`+.`%*`5df]``!`&& 5df]`	ey Whi fy	DUHHYfbgʻcZAYacfmUbX`BUffUhjjY`8Yg][b.`Ghcfm GhfiWhifY`UbX`DUHHYfb]b[
		=b ⁺ h,]g ⁺ kYY_fg ⁺ YWfifY ⁺ kY ⁺ k] ^{***} cc_ ⁺ Uh ⁺ \ck ⁺ ghcf]Yg ⁺ UfY ghfiWfifYX.fYhfcgdYWfjY ⁺ cf ⁺ Wkfcbc ⁺ c[]WU ⁺ 3 ⁺ :cfkUfX a cj]b[⁺ cf ⁺ XYhYfa]bYX ⁺ VmkUmkUfX ⁺]bW ⁺ fg]cbg ⁺ cZ a Ya cfm3 ⁺ <ck<sup>+XcYg⁺h]g⁺g\UdY⁺cif⁺YIdYf]YbW⁺cZ h\Y⁺d]YW[*]3⁺K \UhUfY⁺h\Y⁺YZYWfg⁺cZh\YgY⁺X]ZYfYbh ghfiWfifYg3</ck<sup>
		FYUX]b[g.
		7 c`a ˈHc]V]bʻ"C bYʻA]bi gʻC bY"
		<]`Ufm'AUbhY``"K]bhYf`6fYU_"
		Ch\Yf`fYUX]b[g`

		FYUX]b[g'Zci bX'cb'A ccX'Y.
		8YVcfU\`@Yjmž`"G\]b]b[`U`@][\H"ž`"D`UW]b[`U`7U``"
		5"@?YbbYXm"HYUUbX16]gW]hg"
K YY_``' \$`5df]``!`*`A Um	@Y₩n fY	5XUdh]b[`h\Y`ghcfmiZcfa.`7fYUh]jY`bcb!Z]Wh]cb
		H\]gʻkYY_ʻkYʻk]```cc_`Uhih\YʻhfYbXʻhckUfXgʻbcb! ZJWnJcbʻUbX`\ck`h\Yʻdf]bWJd`YgʻcZg\cfhiZJWnJcb JbZiYbWYʻh\YʻZcfa`cZWnYUhJjYʻbcb!ZJWnJcbʻUbXʻh\Y bUffUhJjYʻYggUm"
		FYUX]b[g'Zci bX'cb'A ccX`Y
		:]cbU`Kf][\hz`7jfcSUfXda_E_S^3UfeaX 6[eSbbWSc6`UW
		<y`yb`; 5a^wufww`a`žx{uf[a`<="" td="" ufbyfž`9ihfuwkg`zfca=""></y`yb`;>
		DWTWUUSEa^[ff YIhfUWkg'Zfca FZW7`UkU/abSWW[S aXFdagT/WS`VEbSU[age`Wee
		@]ghYb]b[g. EZ[fFai`
K_YY_`%\$.`+`A_Um!`% A_Um	Gh X]c	H\]gʻk]```VYʻUʻdfUWfJWY!VUgYX``YWfifYʻh\UhU]agʻhc giddcfhimciʻ]bʻh\YʻZJbU``XfUZhJb[ʻUbX`XYjY`cdaYbhicZ mcif`WfYUh]jYʻkcf_"`KYʻk]```VY``cc_]b[ʻei]hYʻWcgY`m UheiYgh]cbgʻcZghfiWfifYʻUbX`bUffUh]jYʻjc]Wf"`
K YY_'%%'%('A Um'!'&\$ A Um	@YWhifY	8cWaYbh]b[`h\Y`DfcWfgg`cZ7cadcg]h]cb.`h\Y Z]Wf]cbU``UbX`h\Y`]aU[]bUfmž`hfih\`j"`ZJWfg
		=b`h\]g``YWnifY`=f``XYgWf]VY`U`dfcWYgg`cZWcadcg]h]cb]b`fY`Uh]cb`hc`gcaY`cZamickb`kcf_`UbX`X]gW/gg`h\Y jcWUh]cbU``dUh\kUmg`Zcf`diV`]WUh]cb`cZmcif`kcf_
		FYUX]b[g.
		GhYd\Ub]Y`6]g\cd`"K YUh\Yfa Ub"
		GhYd\Ub]Y^6]g\cd`"+b`h\Y`K]`X`h\Y`AU`Y`]g`5`kUmg h\Y`Acghi6YUih]Z`"
K_YY_`&.`&%A_Um!`&+ A_Um		

FYgci fWfg

DfYgWf]VYX F Ygci fWyg

FYWca a YbXYX FYgci fWYg

Df	‰	WΥ	Df	‰		†	\$
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