what progress has been made towards taking stem-cell laboratory inject into clinical practice? In 2000, articulating robust UK Government support, then Health Minister Yvette Cooper proclaimed that stem cells from cloned human embryos “could prove the Holy Grail in finding treatments for cancer, Parkinson’s disease, diabetes, osteoporo-
sis, spinal cord injuries, Alzheimer’s dis-
ease, leukaemia and multiple sclerosis’.

transforming the lives of hundreds of thou-
sands of people”. But 4 years later, the tech-
nical difficulties and biological hazards in-
herent in human embryonic cell develop-
ing treatments from their stem cells led Richard Gardner, Chairman of the Royal So-
ciety Working Group on Stem Cells and
Therapeutic Cloning, to doubt whether this
would ever be a “procedure that becomes
widely available . . . There are concerns about
the efficiency and elaborateness of the
procedure, and it’s going to be very time-
consuming and very expensive”. So, to paraphrase May 25th’s Saving Faces event in
London, UK, are stem-cell therapies hype, or hope, substitutes for something else?

Only two UK groups currently seek to
clone human embryos, both with immediate aims not of developing therapies but of im-
proving embryonic cell development or spec-
sific diseases. Techniques for cul-
turing human embryonic stem cells have ad-
vanced—e.g., allowing them (like adult stem cells) to be grown—but an increasing appre-
ciation of the hazards of embryonic stem cells has rightly prevented the emergence or
immediate prospect of any clinical therapies
based on such cells. The natural propensity
of embryonic stem cells to form teratomas,
their exhibit of chromosomal abnormalities,
and abnormalities in cloned mammals all pres-
ent further problems.

The prospect of having to clone (to obtain
embryonic stem-cells) every patient requir-
ing therapy is surely unrealistic (the Korean
report of cloning human embryos for stem
cells used almost 250 human eggs in gener-
ing a single stem-cell line). If cloning is
unrealistic and/or too hazardous, the auto-
nolysis of embryonic stem cells vanishes and
immunological rejection of embryonic stem cells generated from “for-
eign” in-vitro fertilisation or abortion pre-
vents further problems.

These biological problems only add to the
ethical objections. The Lancet declared in
2001 that: “the creation of embryos solely for
the purpose of producing human stem cells is
do not unnecessary but also a step too
far”. Semantic questions about embryology and
personhood are interesting, if unprovable, but what is unarguable is that the human embryo is alive and is human, and
intentionally ending the life of one human being for the potential benefit of oth-
ers (i.e., for research) is not territory to
which mainstream clinical researchers have
hitherto sought claim—or which ethically
conscious objectors could ever concede.

So is stem-cell research a dastardly, an-
other over-hyped funding gambit? Far from
it, for the embryonic stem-cell story forms
only one aspect. Excitement about the po-
tential of adult stem cells was tempered by
reports in 2002 that in some circumstances
such cells can fuse. Fusion might give a false
appearance of metadifferentiation, the argu-
ment Walther before adult stem cells are not
really multipotent, and are a nonstarter as
an alternative to embryonic stem cells.

Fortunately, for the now highly expectant
patients, the death of adult stem cells were greatly exaggerated. Much re-
search (indeed antedating the fusion
excitement) clearly shows that although fu-
nctional incompetence in certain tissues of
adult (say) bone-marrow-derived stem cells
can also generate multiple lineages without
stem cell fusion. Interestingly, fusion may be an unexpected mechanism of achieving repair, and could potentially offer means of deliver-
ing gene therapy. Normal (bone-marrow-
derived) donor nuclei were found in the mus-
cle of a patient with Duchenne muscular dis-
 ease, over a decade after bone-marrow transplanta-
tion for immune deficiency, of-
f ering proof of principle for fusion of bone-
marrow derived stem cells as gene therapy and presenting tantalising therapeutic pros-
pects. Also, it is now clear that aneuploidy rep-
sents further problems.

Suggestions of low rates of differentiation
to bone-marrow-derived stem cells and inte-
gration in situ, and of questionable differen-
tiation, have also been addressed. Perhaps
the most compelling (and extraordinary) evi-
dence unambiguously confirming the ability of adult bone-marrow-derived stem cells not only to metadifferentiate but also to inte-
grate fully into adult (human) organs, and
survive for decades, comes from postmortem
studies of sex-mismatched recipients of
bone-marrow transplants, showing donor-de-
 rived fully differentiated neuronal cells of a
highly complex morphology apparently fully
functioning within the host brain, with no
evidence of fusion.

We now know that bone marrow-derived stem-cells circulate systemically and ac-
tively migrate into damaged tissue to con-
tribute to spontaneous repair. Experi-
mentally, therapeutic benefit occurs in nu-
merous disease models but, importantly,
repair by bone-marrow-derived stem cells does not stop at the laboratory door. Safety data
from 50 years of clinical bone-marrow trans-
plantation, during which nonhaemopoetic
stem cells have inadvertently also been
transplanted, and the accompanying clinical
expertise in collecting, handling, freeze-stor-
ing, thawing, and delivering marrow, have
safety allowed a rapid translation of bone-
marrow-stem-cell science from laboratory to
clinic. Controlled trials have shown signifi-
cant benefit of marrow-derived stem-cell therapy in myocardial infarction, and trials are planned or underway in chronic cardiac
failure, stroke, and other diseases: reports of
successful adult stem-cell therapy in myo-
cardial infarction, and trials are planned or
underway in chronic cardiac failure, stroke, and other diseases: reports of successful
adult stem-cell therapy in patients with cor-
nal disease have just appeared. The next few
years, not decades, will show whether adult
stem-cell treatments are to join the main-
stream therapeutic arsenal.

**EXHIBIT 3**

**BENEFITS OF STEM CELLS TO HUMAN PA-
TIENTS—ADULT STEM CELLS VS. EMBRYONIC
STEM CELLS (PUBLISHED TREATMENTS IN
HUMAN PATIENTS)**

<table>
<thead>
<tr>
<th>ADULT STEM CELLS</th>
<th>EMBRYONIC STEM CELLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Brain Cancer</td>
<td>1. Brain Cancer</td>
</tr>
<tr>
<td>2. Retinoblastoma</td>
<td>2. Retinoblastoma</td>
</tr>
<tr>
<td>3. Ovarian Cancer</td>
<td>3. Ovarian Cancer</td>
</tr>
<tr>
<td>4. Skin Cancer</td>
<td>4. Skin Cancer</td>
</tr>
<tr>
<td>5. Testicular Cancer</td>
<td>5. Testicular Cancer</td>
</tr>
<tr>
<td>6. Tumors abdominal organs</td>
<td>6. Tumors abdominal organs</td>
</tr>
<tr>
<td>10. Acute Myelogenous Leukemia</td>
<td>10. Acute Myelogenous Leukemia</td>
</tr>
</tbody>
</table>

**CONCLUSION OF MORNING BUSINESS**

The PRESIDING OFFICER. Morning business is closed.

**PROTECTION OF LAWFUL COMMERCE IN ARMS ACT**

The PRESIDING OFFICER. Under the previous order, the Senate will re-
sume consideration of S. 397, which the clerk will report.