Targeted agents hold promise for non-invasive in vivo imaging, therapy, and monitoring of diseases. Foundational work focused on imaging and therapy of cancer has centered primarily on the use of $^{18}$F, $^{90}$Y, $^{99m}$Tc, and $^{131}$I radionuclides. Use of these agents often requires conjugation to a biological targeting vector, a peptide or monoclonal antibody (mAb), to investigate biological processes. To truly be effective the physical properties of the radionuclide must be suitably matched to the time required for chemical derivatization, conjugation, to reach maximal uptake of the targeting vector at the targeting site. Radioisotopes of arsenic, $^{72,77}$As, have half-lives well-matched for conjugation to peptides or mAbs. Even with favorable decay characteristics, production, and separation pathways, the ability to use radioarsenic has largely remained undeveloped. It is the aim of this work to address this issue through the identification and synthesis of no-carrier added radioarsenic complexes.

Macroscopic synthesis of AsPh(S-$R_n$-S) precursors to no-carrier added $^{72,77}$AsPh(S-$R_n$-S) complexes, synthesis and no-carrier added radioarsenic labelling of a simple trithiol ligand, and two linkable trithiocyanate precursors, a carboxylic acid and “clickable” alkyne, are described in detail. The development of a radiochemical separation procedure to separate no-carrier arsenic, $^{77}$As, from a neutron irradiated germanium dioxide target, evaluation of a novel copper selective resin, and synthesis of any additional unmentioned compounds are found in the attached appendices.